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WHO SHALL SAY?

CHEMICAL INDUSTRY in this country is essentially nationalistic in the sense in which that term is used today. Its close relation to the national defense and to the public health has always been a major consideration in tariff matters. Under Democratic and Republican administrations alike, chemicals have received a larger measure of protection than most other manufactured commodities. And despite these tariff barriers, the United States has risen in recent years to the leading position in the chemical foreign trade of the world, with imports slightly exceeding exports in normal times. Now comes the question dictated by the new tariff policy of reciprocal relations: How can imports be increased without adversely affecting important domestic industries that have been built up since the passage of the famous dyestuff tariff of 1916?

One scheme seriously proposed by some of the President's advisors on commercial policy, would call for an alphabetical grading of American industries on the highly debatable basis of their "relative right to be kept alive." In the beautiful theory thus set up, certain chemical industries would undoubtedly be given a high rating because of their strategic importance to the nation and, under this plan, these would be protected against ruinous competition even to the extent of invoking embargos or quota restrictions. Others, however, might be less fortunate and would fall within the groups where tariff bars are to be lowered in order to promote international trade. And undoubtedly there would be some down in the lowest grades that would have to be sacrificed so that American cotton or wheat could be sold abroad. Naturally, the question is going to be asked: Who is to have this power of life and death over our industries? Who is to say that the manufacture of bromine is in Grade A, for example, but that our new iodine industry falls in Grade X and must be sacrificed so Chile may buy American automobiles?

The powers the President has asked from Congress seem, at first glance, to be not greatly different from those now given him in the so-called "flexible" tariff provisions which the Supreme Court has held to be constitutional. But there is the very significant difference that under present law an investigation of all the facts must be made, public hearings must be held, and the Presidential action is taken only on the studied recommendation of the Tariff Commission. Somewhat similar process is followed in Great Britain where tariff changes are made only after the interested parties have had an opportunity to present, and if necessary prosecute, their cases in court. A number of other countries have elaborate quota systems outside of immediate legislative control, but very few are willing to leave such matters to the arbitrary power of even an acknowledged dictator.

If our American ideas of government are not to be discarded entirely, it is highly desirable that very definite limitations be placed on the extent to which these powers may be used in the present emergency. Equally important, the methods and procedure by which they are to be applied must be carefully studied and clearly defined. Chemical industry has nothing to fear if given a fair opportunity in public hearing to present the facts in their true significance. On the other hand, it must be apparent that the industry has little to gain directly and much to lose if there is to be a large increase in chemical imports. Indirect benefits that may result from any general stimulation of foreign trade will prove extremely costly if paid for by the sacrifice of essential chemical industries.

EDITORIALS

Questioning Our Way Toward Recovery

WITH EIGHT and a half months of experience in industrial self-government behind them, first the American people and then American industry went to Washington to appraise the NRA in its recovery attempts, to question and to criticize. What did they find and what did they decide? They found organized labor agitating for a 30-hour week, and Congress giving more than desultory attention to the Connery Bill, which would make the short week mandatory. They found more than 9 million people still unemployed, with others shortly to be in the same situation, as CWA abandonment is completed. To the horror of some, they found the New Dealers with no intention of reviving *laissez faire* at the termination of the emergency. They heard praises and recriminations, enthusiasms for industrial cooperation and fears for grabbing and monopolistic price fixing. And finally they found that both the President and the Recovery Administration entertained hopes for shorter hours and higher wages, although nothing so drastic as labor demanded.

Withal, the meetings were hopeful, friendly and constructive. Opposition to NRA was based not on its aims but on its methods. Everyone granted the need for more equitable distribution of wealth, for more civilized trade practices, for somewhat less ruggedness in the individualism of business and industry. But few were there who did not view with trepidation the hour-lowering and wage-raising aims of the Administration. What consistency, they questioned, is there in simultaneous attempts to raise costs and lower tariff bars? How, they wanted to know, are we going to raise standards of living in the face of a probable decrease in production? How dispose of even this smaller quantity at still higher prices?

Any attempt at the simplification of economic problems seems inevitably to lead to over-simplification. Mathematics fails; the demonstration is hole-proof, but human psychology throws the proverbial wrench into the machinery. What simpler, argues William Green, than to reduce hours to a point where all who today would be out of jobs at the rate of activity of 1929 can be reemployed? To complete the logic of the argument he postulates an increased wage rate which would still buy all the output.

Now it is worth noting that there is nothing wrong with the logic of this demand. In an inanimate state, obeying the laws of mathematics, it would work to perfection. Equally logical and equally rigorous from a mathematical standpoint is the retort of Ralph E. Flanders who, from his position as a builder of producers' goods, sees unemployment and lowered standards of living in further work sharing. After all, he argues, the production of a people is its income. Raise production and you raise income. With nearly unlimited demand for most commodities, all that is necessary is to bridge the gap between production and the ability to consume. Stimulate capital goods industries by buying new equipment, he says, hire more men, increase production, maintain wages, hours and prices. Again, his formula is exact, unassailable and theoretically the perfect road to recovery.

Unfortunately, human perversity, with its inability to fit into a pattern, remains the stumbling block. Certainly, hours and efficiency must bear an inverse relationship if living standards are to be maintained. Certainly, hours must fall less rapidly than efficiency rises if standards are to be improved. Where between the extremes is the ideal? Which is the course that leads to the high and stabilized plane of economy that is our goal? It seems to us that the end lies more in a philosophy than in any specific course of action. How can we do better than to continue as we have been going in recent months, tacking this way and that as the wind may shift, but tending always toward the same spot on the horizon?

Nitrogen In the News

NITROGEN is featured again in the foreign news, with cabled stories, largely misleading but worthy of note and comment. The movement of nitrate through the Panama Canal since Jan. 1 has been reported as 700 per cent higher than the year before. From this fact a number of weird conclusions have been drawn. Some have argued that Japan and Russia must be stocking up for the much talked of Far Eastern conflict. Will Rogers has all Europe "a'fertilizing." Others conclude that Chile is at last to have its comeback. Some even claim that agriculture must be out of its depression. All of these conclusions appear false, for the real facts are about as follows:

The new movement through the Canal represents merely a start toward rebuilding visible stocks outside of Chile that have been significantly depleted during the period when exports from that sorely-tried nation were at an extremely low ebb. United States stocks last year shrank from about 400,000 tons to a normal carry-over of about 100,000 tons. It is probable that European stocks shrank in somewhat the same way, though probably not in as large a percentage of former totals.

The Chilean government has taken over the nitrate marketing business under a law that took effect Jan. 8 of this year. Its credit enables direct action for export that was not possible when the industry was trying to proceed under the much-harassed Cosach organization. This permits movement of stocks, but does not in any way reflect sudden new consumption or any greatly improved prospects for the natural nitrate industry.

As a matter of fact, the American synthetic industry has just received a sizeable stimulant. A large contract has been closed between American and French interests for the sale of 40,000 tons of synthetic sodium nitrate from Hopewell, Va., at an f.o.b. plant price said to be approximately $1,200,000. Simultaneous contracts provide for French purchase of 20,000 tons

from Norway and 10,000 tons from Germany. Probably there will be some natural nitrate imports also, but they are still clearly at a disadvantage compared with synthetic nitrogen products.

Chemical industry finds considerable satisfaction in the success of synthetic products which now supply about 80 per cent of the world requirements of fertilizer and industrial nitrogen. But we cannot fail to regret the consequence in serious distress to the whole Chilean nation. That country with the burden of unemployment relief which is almost more than its curtailed income can tolerate, is a serious factor retarding the whole world's business.

Consider the Tireless Electron

THAT THE electron tube in its various forms is one of our newest servants, and one day to be one of the most useful, will be news to no one who reads these pages. And yet, it is still a good deal of a mystery, even to its familiars. Some of the possibilities are known, but a million others are not even imagined. Take the ingenious case described to us the other day by an engineering friend whose footsteps, to our good fortune, led into the sanctum. He had been troubled with cloudy filtrates caused by breaking of filter cloths. Why not set a photoelectric cell to watch for breaks? Why not, indeed? The new watchman worked to perfection. Other photocells are watching for paper breaks, for fires, for improper softening of water, for faulty operation of one sort or another. Judging from these practical uses made of the electron's effortless migration, is it too much to predict the day when electron tubes will largely remove the burden of human supervision?

Natural vs. Synthetic Sources of Acetic Acid

THERE has been much loose talk lately about acetic acid. This comment comes from numerous sources, some of which are competitive, others of which have their own independent, more or less exclusive markets. Taking together the producers and users, a wide section of chemical industry is interested.

At the present time acetic acid and its major first products come from four sources—calcium acetate from wood distillation; acetic acid recovered directly in wood distillation plants; acetic acid made by synthetic processes in the United States from carbide and, experimentally at least, from petroleum; and imported acid, acetates, and acetic anhydride, also mostly of synthetic origin. There has been some talk that the wood chemical industry would seek to have the imported material cut off and a tax placed on domestic synthetic material. Some members of that industry apparently did have that ambition. Fortunately, however, a saner view prevailed and the industry realized both the futility and the danger in such a negative procedure.

There is no longer evidence that an internal controversy of this sort is to be raised among these chemical competitors. In fact, one of the prominent spokesmen of the Wood Chemical Institute has taken occasion to assure *Chem. & Met.* definitely that there is to be no attempt to attack either importers or synthetic producers of the United States. Any other course than this would have been unwise. It could have led to but one conclusion, bitter controversy, hard feeling, and a loss of market on the part of the wood chemical makers.

Synthetic acid is today available at somewhat lower prices than are comfortable for the charcoal byproduct manufacturer. However, this fact but reflects scientific progress. Those customers who make acetates and anhydride and those many industries that use acetates and other chemicals derived from acetic acid cannot be expected to pay more for a byproduct than the substitute synthetic product costs. Progress must prevail and the benefits of progress in the form of lowered prices to users, all for the benefit of the ultimate consumers, are only to be expected.

Honest Cost Keeping In Governmental Competition

MANY OF THE codes define selling below cost as an unfair practice on the part of industry. Now comes industry saying that selling below cost on the part of Government is equally unfair. Thus does a National Association of Manufacturers Committee turn back on the Government a very proper criticism of its business practices when in competition with private industry.

The recent report by the general counsel of N.A.M. urges support for H.R. 6038, which is a bill providing for the establishment of standard systems of cost accounting and reports in the executive departments of the Government. This bill would also require that due attention be given to matters of capital cost, depreciation, and overhead. It would expressly forbid the omission of these items in "estimates" submitted by one department to another in competition with private agencies. Under existing conditions the actual cost to the Government is always far above these "estimates," and usually above private bids.

Chemical engineers can well support the N.A.M. movement, working through Dr. Charles J. Brand, executive secretary of the National Fertilizer Association, who is a member of this committee. Process industries have much at stake, especially in the competition threatened by extensive manufacture of fertilizer chemicals and fertilizers. These matters should be handled in a fair, frank fashion, taking into due account all elements of cost. The great economic experiments of T.V.A. should be carried on under a cost system that will free it of any suspicion of improper practice on the part of Government. Only in that way can its findings prove of lasting benefit to the public.

Foundation construction, involving great difficulty, was accomplished by supporting a reinforced concrete mat on 75-ft. piles

Grande Ecaille Sulphur Development Overcomes Marsh Conditions

By WILSON T. LUNDY

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PRODUCTION of sulphur from salt domes in Louisiana and Texas originated with the operations of the Union Sulphur Co. at Sulphur, La., followed by those of the Freeport Sulphur Co. at Bryanmound, Tex. Including the present development of Grande Ecaille by the Freeport Sulphur Co., which constitutes the tenth dome to be equipped for the production of sulphur in the Gulf Coast, less than 10 per cent of all the known domes have proved to contain sulphur in commercial quantities.

The Grande Ecaille salt dome is in the tidal marsh of the Mississippi River delta in Plaquemines Parish, La. It is 10 miles southwest of the right descending bank of the river, approximately 45 miles below the City of New Orleans and is within 4 miles of the shore line of the Gulf of Mexico.

Characteristic of the delta region, the terrain consists of a low, flat, uninhabited area of marsh land intersected by many shallow lakes and bayous. With the exception of salt grasses, the region is devoid of vegetation and presents, in all directions, an unobstructed path to the vagaries of the winds. The successions of growth and decay of these grasses has formed a brown fibrous mat varying in depth from a few inches to several feet. This mat of vegetation virtually floats on an ooze that is several feet thick and is composed of alluvial sediments and very fine sand, and the whole is underlain by an unctuous clay. The decayed vegetation from the upper layer when dried has a peaty appearance.

The early prospecting of the dome was in search for oil, the discovery of indications of sulphur being incidental to these operations. The mineral rights are jointly held by the Humble Oil & Refining Co., the Gulf Refining Co. of Louisiana and the Shell Petroleum Corp. Prospecting was delegated to the Humble Oil & Refining Co., and initial operations began in July, 1929. While the dome is within 10 miles of the Mississippi River, there existed at that time no practicable means of communication between these points and it was necessary to ship all materials required for the work from Harvey, opposite New Orleans, a distance of about 70 miles. The route followed led through a number of bayous and lakes which are all shallow, making the barging and towing of materials not only costly but hazardous.

At two locations in the marsh large wooden mats were used to support the rig and necessary equipment. This did not prove satisfactory because the unstable character of the soil permitted the derrick to settle un-

Based on a paper presented by the author before the American Institute of Mining and Metallurgical Engineers, New York, Feb. 22, 1934.

evenly. Hence, in subsequent operations the derrick was set on piling and the power to operate the equipment was furnished by the diesel-electric plant. During the drilling operations sulphur water was encountered in the second well at about 1,735 ft., and in the third well drilled, traces of sulphur were found in the broken cap-rock foundation at 1,527 ft. Cores from a well drilled at a later date were considered sufficiently rich to warrant the prospecting of the dome for sulphur.

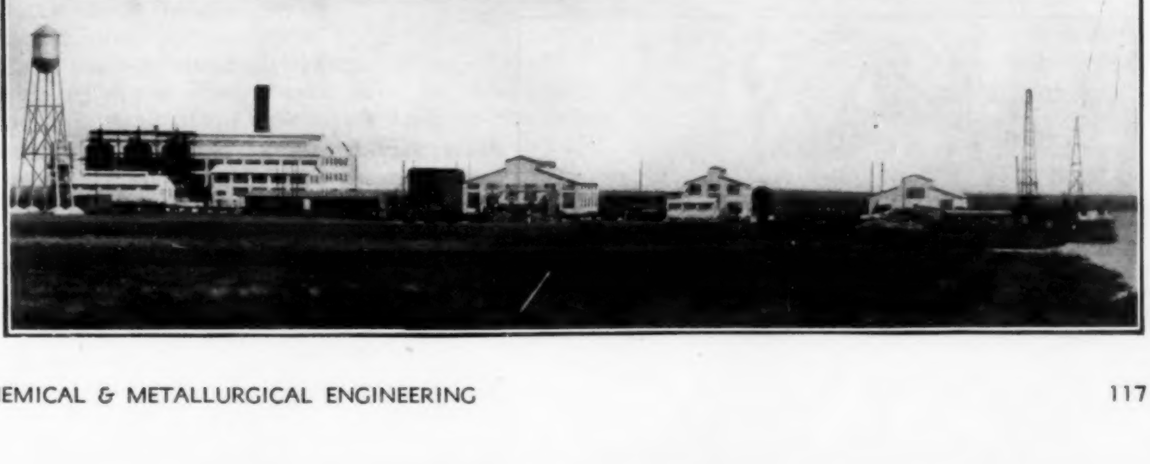
At this point, the Freeport Sulphur Co. commenced negotiations with the three oil companies mentioned, which resulted in the acquisition of sulphur rights by the Freeport Sulphur Co. early in 1932. A program calling first for prospecting and subsequently for development was immediately inaugurated. Simultaneously, with prospect drilling, a torsion balance survey was made to determine the size, depth and configuration of the cap-rock area. The prospecting of the dome for sulphur began in April, 1932, and within a year 18 wells were drilled and sampled.

To overcome the drilling difficulties encountered by the Humble Oil Co., floating drilling equipment was employed. Two welded steel barges were specially designed to support and house the entire drilling units. Each unit consisted of a 96-ft. derrick, 100-hp. engine for the drawworks, 50-hp. engine for the slush pump, electric lighting system, mosquito blowers, water pump, tools and equipment for rotary drilling rig. The drilling barges, measuring 36 by 80 by $6\frac{1}{2}$ ft., were divided into watertight compartments by longitudinal and transverse bulkheads, which also served to strengthen them. The two rear compartments served as slush pits to hold the drilling mud, the forward compartments serving as water-ballast tanks to maintain the barge on an even keel. An opening 4 ft. wide, extending from the bow to the center of the barge, provided a means for moving on or off a well location where casing had been set. Four 36-ft. spuds made of heavy steel pipe, one at each corner of the barge, were used to hold it in position over a location. In operating the drilling barge the procedure used was to dredge a canal 45 ft. wide by 6 ft. deep to the location. The canal was then enlarged at this point to 70 ft. in width for a distance of 175 ft., in order to facilitate the handling of material barges near the drilling location. Upon completion of the canal the drilling barge was towed into position, anchored in place by means of the spuds, and drilling begun immediately. This method of operation was found to be particularly well adapted to marshy and shallow lake locations at Grande Ecaille, with a great saving in expense and time of moving and setting up.

The sedimentary formations overlying the cap rock consist of gumbo, sand, sandy shale and a few boulders, and offered little resistance to drilling. At each location, approximately 80 ft. of $15\frac{1}{2}$-in. surface casing was set, then a $13\frac{3}{4}$-in. hole was drilled to the cap rock, where 10-in. casing was set and cemented at a depth usually of about 1,250 ft. The thickness of the cap rock in tne wells drilled averaged about 250 ft., consisting of limestone, calcite, gypsum, anhydrite and sulphur, and with traces of pyrite, barite and celestite.

The cap-rock area within the 2,000-ft. contour as outlined by the torsion balance totals 1,100 acres. Of this area, only 209 acres has been drilled and proved to contain sulphur in commercial quantities. The remaining undrilled area is considered a promising potential but has not been proven.

During the prospecting period the engineering department of the Freeport Sulphur Co. prepared and carefully studied several tentative plans for equipping this property, and in this work the J. F. Coleman Engineering Co., of New Orleans, and the J. G. White Engineering Corp., of New York, assisted and were retained as consultants both for the preliminary design and during the construction period. The chief problem in constructing and equipping a property with terrain conditions as described above lay in the selection and design of foundations. The plan finally adopted, after exhaustive tests, consisted of heavy rein-



Left: Part of the field, showing derricks supported on mats

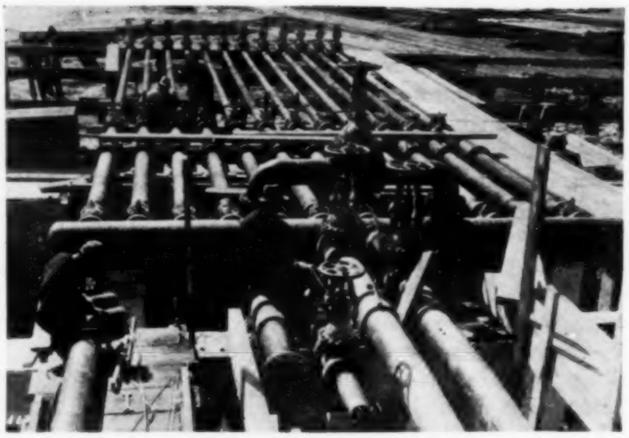
Below: The plant shortly before production was started

forced concrete mats supported by piling for the foundations for buildings, and hydraulically made fills for the vat foundations and mining area. The vats are also supported by piling.

A site on the Mississippi River accessible by both rail and highway was selected and purchased as a base for receiving and handling materials and for the general transportation of sulphur. The river terminal has been named Grandeporte, La., where the mine office, laboratory and a model industrial village are being constructed, with a school, community center, parks and recreation facilities for the employees and their families. To provide for rapid and economical transportation from Grande Ecaille operations, a canal approximately 100 ft. wide, 9 ft. deep, and 10 miles long was dredged, involving the movement of some 2,000,000 cu. yd. of dirt. Grandeporte is reached by the New Orleans and Lower Coast Railroad, a branch of the Missouri Pacific Railroad System. A river dock 1,000 ft. long has been provided for the accommodation of vessels having a draft of as much as 35 ft.

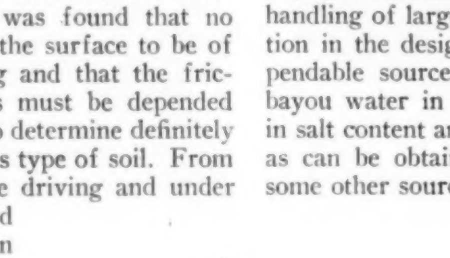
In designing the foundations for the plant numerous tests were conducted to determine the feasibility of using piling foundations, and also to select the best sites for plant and other buildings. It was found that no stratum existed sufficiently close to the surface to be of any value for supporting the piling and that the friction between the soil and the piles must be depended upon solely. Tests were conducted to determine definitely the supporting power of piling in this type of soil. From the behavior of the piles during the driving and under these load tests, 75 ft. was decided upon as the proper length for use in the main structures. No settlement occurred when a weight of 10 tons per pile was placed on a group of 4 in a cluster of 16.

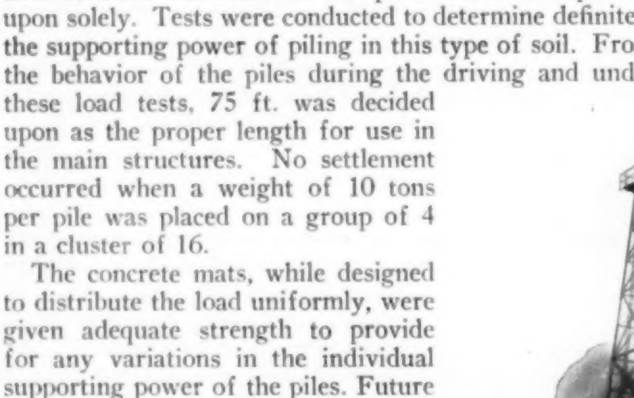
The concrete mats, while designed to distribute the load uniformly, were given adequate strength to provide for any variations in the individual supporting power of the piles. Future requirements were also taken into consideration, since it is impossible to satisfactorily alter these foundations when once they are installed. The foundation of the boiler plant required some 3,500 untreated piles, 75 ft. long, driven on approximately 2 ft. 8 in. centers. The total requirements for piling for the project will run in the neighborhood of 18,000, varying in length from 40 to 80 ft. Approximately 10,000 cu.yd. of concrete was used to provide adequate foundations for the numerous buildings.



Field relay station during construction

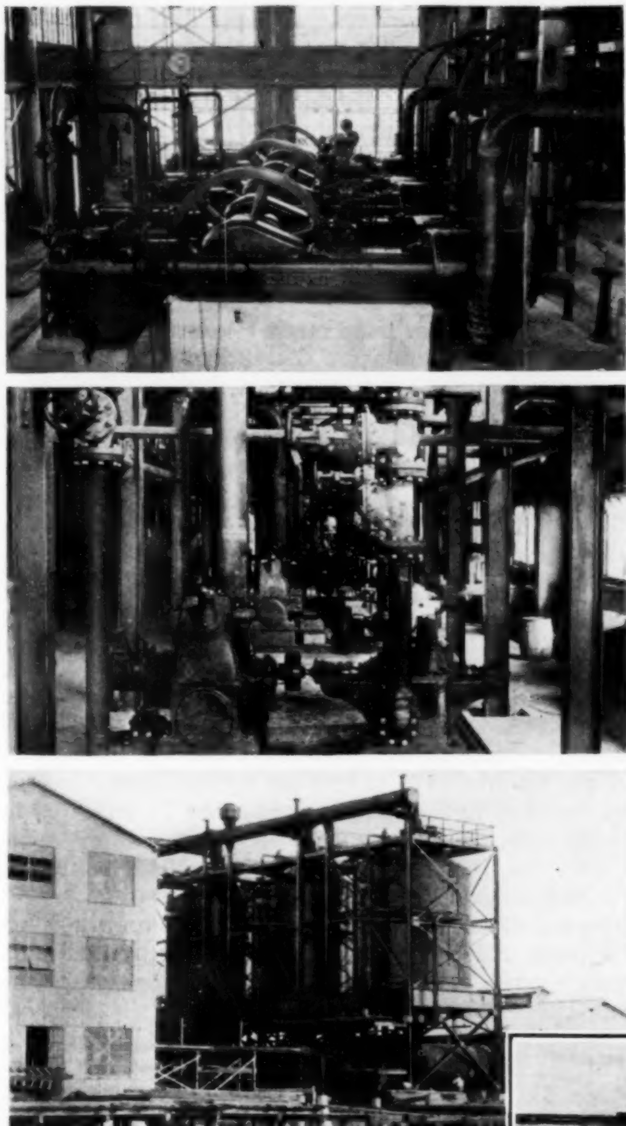
Since the mining of sulphur involves the heating and handling of large quantities of water, a major consideration in the design of the plant was the selection of dependable sources of water and fuel. As all lake and bayou water in the area surrounding the plant is high in salt content and encrusting solids, and such well water as can be obtained is brackish, it was imperative that some other source be developed. Investigation developed that water comparatively low in salt content could be obtained from the Mississippi River and accordingly an earthen reservoir to hold 50,000,000 gal. was constructed for settling the turbid water from this stream before pumping it to the plant. An intake pump station for delivering the river water to the reservoir and a similar pumping plant at the reservoir for delivering the water to the power plant were required. A pipe line approximately 9 miles long conveys the water to the plant and the power required for pumping is transmitted over an electric transmission line of the same length. Storage for 2,000,000 gal. of water is provided at the plant to maintain continuous operation should it be necessary to make repairs to the reservoir, pumping equipment, or pipe line. The Mississippi River water, while very low in salt, contains sufficient encrusting solids to make treatment advisable in order to prevent objectionable deposits in boilers, pipe lines and heaters. The method adopted includes hot lime-soda treatment for the boiler water and hot lime treatment for the water used in the mining operations. Soda ash is not required for the mine water, as there is no concentration of the water such as occurs in





Above: Derrick barge used in the early drilling

Left: Hydraulic fill was used to build up the mining area to an elevation of 4-8 ft.



Plant views shortly before completion: Top to bottom, group of air compressors: one line of mine-water pumps; hot-process water softeners

Tramway connecting plant and field area

boilers, and the permanent hardness, remaining in solution, does not cause deposits in the mine system.

Fuel oil is received by tanker and is discharged into a storage consisting of three 55,000-bbl. tanks, located 1,500 ft. from the river and built on an earth fill topped with sand. The fuel oil will be conveyed to the plant by barges operating through the dredged canal and discharged into two 15,000-bbl. firing tanks. The firing tanks as well as the water-storage tanks were built on piling foundations capped with concrete mats. The fuel oil flows from the firing tanks to the fuel-oil pumps in the plant by gravity and is heated and pumped to the burners under high pressure.

The power plant and all other permanent buildings are constructed of steel with corrugated asbestos roofing and siding, using aluminum bolts and clips of high tensile strength for fastenings. Owing to the exposed location, the steel frames are all designed for 125-mile winds. All window sash is of galvanized steel, and gutters and downspouts are aluminum, to minimize the effects of corrosion. The floor of the plant is at an elevation of 12 ft. above mean Gulf tide, or 11 ft. above the surrounding marsh, this being considered ample to protect the plant during storms and high tides. The piling was cut off about 1 ft. above the marsh, capped with a thick concrete mat, and piers constructed to support the plant floor and equipment. The space between the floor and the mat furnishes a storage for water and provides a convenient suction inlet to the pumps supplying the water-treating plant.

Considering the unfavorable location, construction costs have been kept relatively low. The foundations for the auxiliary buildings, such as the machine shop, blacksmith shop and warehouse, average $2.11 per square foot of floor area. The plant building, which was constructed on a concrete mat 2 ft. 6 in. thick, with extra heavy piers closely spaced supporting the equipment and plant floor, equivalent in area to three supporting floors, ran $6.60 or an equivalent of $2.20 per each square foot of floor area. Superstructures fabricated and erected in place complete, including siding, roofing, windows and doors, averaged 5 cents per cubic foot of enclosed volume. Concrete costs were $17.30 per cubic yard including form work and reinforcing.

In passing through the water-treating plant the water is heated, treated, aerated and filtered. The equipment consists of three treating units each having an exhaust-steam jet heater and vent condenser, sedimentation tank and two filters. Exhaust steam from the various prime movers in the plant is utilized in preheating the water for treatment. Chemicals are automatically proportioned to the amount of water flowing through the treating plant. The water is heated to about 218 deg. F. at the water-treating plant, which is adjacent to the boiler plant.

High-pressure heater-supply pumps take the water from the treating plant and pass it in direct contact with live steam at 120 lb. pressure in high-pressure heaters, where the temperature of the resulting mixture is raised to approximately 350 deg. F. and pumped to the field for mining purposes. All pumping equipment is of turbine-driven centrifugal type, turbines being considered most reliable in maintaining the continuity of operation that is essential to sulphur mining.

Six 860-hp. bent water-tube Stirling boilers with air-cooled furnaces are used in the boiler room for generating steam and are designed to operate at 200 per cent

of builder's rating. The boilers are set high to provide ample furnace volume for combustion of oil, gas or pulverized solid fuel and to provide for rear firing. Space and foundations have also been provided for equipment and facilities for pulverized fuel.

Three 750-kw. noncondensing turbogenerators provide current for drilling wells, pumping water, loading sulphur and all other operations incident to the mining. Three 800-lb. high-pressure air compressors supply air to the field for pumping the sulphur wells. The cost of steam used in driving the generators, compressors and pumps is negligible because all exhaust steam is returned to the mine-water system through the low-pressure heaters and water-treating plants.

In order to maintain a relatively low formation pressure, all the water injected into the formations must be bled from the mine. This waste formation water is conveyed to a treating unit approximately 1,000 ft. from the power plant, where the objectionable sulphide impurities are removed before disposal.

The low marshland constituting the mining area has been filled to an elevation of from 4 to 8 ft., and this work will be carried on progressively by a 12-in. diesel-electric dredge. Hydraulic fills also include the area surrounding the plant, in order to preserve the piling as well as for operating convenience. The area selected for sulphur storage has been filled to a height of 12 ft. to protect stocks from water. A tramway for the transportation of materials has been constructed on piling bents to connect the mining area and the plant area, a distance of approximately 4,000 ft. These bents also carry the various pipe lines required for steam, water and air. The completed project will involve the dredging of more than 2,000,000 cu.yds. of earth fill, and excavation to a depth of 40 to 50 ft. to obtain suitable material.

With the completion of the field fill, the use of the drilling barges and floating equipment has been discontinued and the derricks have been erected on mats. Motor drives have been substituted for the gasoline engines, power being supplied by a high line from the plant.

In the mining of sulphur, fuel constitutes one of the major items of cost. High plant efficiency is, therefore, of great importance. It is estimated that an 80 per cent boiler efficiency and 77 per cent over-all efficiency will be obtained in the plant. Of the total heat recovered from the fuel, approximately 3 per cent is usually required for the handling of liquid sulphur in pipe lines and in relay stations on the surface, less than 1 per cent for auxiliary power to drive generators, pumps, compressors, etc., leaving approximately 97 per cent for the injection into the formation. Operating the boilers at 200 per cent of the builder's rating, approximately 2,800,000 gal. of water per day at 350 deg. F. can be furnished to the mining area through the booster pumps at a pressure of 250 lb. per sq.in. This quantity of water is made up approximately of 75 per cent mine water and 25 per cent boiler water.

The productive capacity of any Gulf Coastal sulphur mine is highly variable. With similar plant capacities, the production of one mine rarely equals that of another. The production varies from day to day and no area or even individual wells yield identical results. This variation of production is primarily due to the ever-changing thermal efficiency of the rock structure into which the water or heat is injected. Many factors upon which little or no control can be exercised enter into the thermal efficiency of individual deposits, areas or wells. The major factors are probably the physical nature of the rock structure, rapidity of subsidence, reserves, concentrations and recovery of sulphur. An estimate of the rate of production is, therefore, difficult to determine.

The sulphur produced at the individual wells is lifted to the surface by the means of an air-lift. The molten sulphur is then conveyed from the wells to the relay station, whence it is pumped to a vat and allowed to cool and solidify. The weight per square foot of area of a sulphur vat 40 ft. high averages about $2\frac{1}{4}$ tons, and to prevent excessive settlement the supporting power of the vat area has been increased by 60-ft. piling placed on 8-ft. centers.

The solidified sulphur in the vats, when broken down by blasting and loaded on a belt conveyor by means of electric shovels, is discharged into barges for transportation. The broken sulphur is barged through the canal to the river. At this point, the sulphur is unloaded from the barges by means of an electric crane and can either be placed in storage or conveyed by a belt, at the rate of 500 tons per hour, over the docks into the holds of vessels or to barges in the Mississippi River.

Above: 50,000,000-gal. reservoir at Grandeport

Left: Barge terminal and river dock at Grandeport

Shall We Throttle Invention By Code?

By CROSBY FIELD
Chemical Engineer
Brooklyn, N. Y.

ALTHOUGH I have the utmost admiration for the tremendous job the NRA is seeking to accomplish, nevertheless it seems to me that there are phases of the movement that work against recovery, rather than toward it. One of these is the clause present in many of the codes, making it mandatory for you to ask your competitors if they want you to build a plant. Naturally, their answer is "no," perhaps not directly, but just as positively through the simple expedient of long investigations and failure to act, that is, by means of the "pocket veto."

The clause to which I refer is the one which seeks to control production through controlling construction of additional manufacturing facilities. Such clauses require a certificate of public necessity or convenience, granted after hearings and investigations held by the Code Authority of the industry involved. And since the Code Authority is heavily weighted in favor of the large and established interests in the industry, its reaction is obvious.

Although there may be some justification for this degree of control where exact duplication of facilities is contemplated, the tendency also extends to the prohibition of modifications and variations of the standard products of the industry. The Code Authority thus endeavors to extend its power not only over the present, known manufactures of the industry, but even over those which may be born in the future. This is a wonderful opportunity to force the public to continue paying returns upon a large capital investment which otherwise might be made obsolete through new inventions.

Our economic history has shown that eras of prosperity are always accompanied by, and largely created by, the expenditure of comparatively large sums in the construction of capital goods, built because of a change in the manner of living of a substantial portion of our population. Such new construction is always accompanied by activity of small enterprises, which are to a great degree responsible for the activity. Inventions so exploited always play an appreciable part in the beginning of new eras of prosperity.

It is this sort of progress at which the "birth-control" clauses in many codes strike. Under the guise of "control of production" they return to the medieval method of preventing progress by outlawing new plants, thus protecting the investment in present productive facilities of those represented on the Code Authorities. In the case of at least one small company, to my knowledge, the clause has been so used in spite of the fact that the company is selling newly invented products and equipment covered by United States patents.

This sort of thing is not new by any means. Recall, for example, that 100 years ago there were 20 steam coaches operating on the roads of England, and that all of them were very soon thereafter legislated out of existence. Within the past three decades automobiles in England had to be preceded by a man on foot with a flag, while at about the same time our pioneer automobile builders and operators were enjoying arrests for running the contraptions that would render obsolete so many horses and other vested rights of the horse raiser and wagon builder.

This brings up an interesting situation: A change in the manner of living inaugurates a large number of small companies to fulfill new wants. In the production of factories for these new wants, capital goods construction plays a big part in reemploying labor and in bringing industry out of depression. And yet, if you invent a new method of doing anything in one of these industries that has a prohibitive or a permit clause in connection with the erection of capital goods, you are forced either to find somebody in the conspiracy against you who is willing to put in your process or equipment, or remain out of the business. Since most of the newer industries have grown up as rejects from old industries, under the new method the old industry becomes an Anti-Patent Office.

Hence it seems that in order to obtain the advantage of monopoly, and perhaps of permanent existence in this country, all you have to do is to have been engaged in an industry prior to the acceptance of that industry's code. From that time on you must buy the inflated and over-valued capital stock of one of the companies in that industry, or you won't be permitted to enter. Having done this, your production capacity cannot be changed without permission of the industry. Progress is prevented by the simple method of establishing a monopoly based upon prior investment.

If these birth-control clauses must exist in codes, it would seem that at least a compromise with modernity could be effected by exempting from them any plant proposed to be built in accordance with patents duly issued by the Patent Office. Otherwise, nothing is more certain than that everything possible will be done by industry to prevent the new and usually small enterprises from getting started. If any one industry is to decide for itself what progress it is to be permitted to make, then it is obvious that the representatives of present capital will endeavor to prevent progress. The consumer, who is ultimately to benefit, is the one to wish progress, but he has no standing in the industry.

The country is ripe for the rebuilding which will accommodate it to the changed manner of living now available in connection with new inventions. Yet, today we find numerous obsolete plants which will not install this new equipment and thus give employment in its building. Under NRA we are reverting to the period wherein it was within the power of a hostile group of men to prevent the use of invention and thus to safeguard the capital investment of their interests. In fine, these so-called "control of production" clauses permitted in the various codes tend to stabilize the consumers goods industries and to protect them to a degree that may eventually kill all mechanical progress and deprive the public of the benefits it receives therefrom. Monopoly based upon prior investment takes the place of progress based upon mechanical invention.

Combination Process Coolers Reduce Operating Costs

By C. C. CHRISTENSEN
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REFRIGERATION by means of flash evaporation under vacuum has recently attracted widespread attention. This mounting interest has taxed the ingenuity of commercial manufacturers to minimize operating costs. One method, for use in process cooling when it is impractical or uneconomical to evaporate a portion of the main body of the process solution, has effected a material reduction in operating costs through the installation of a multi-tubular exchanger directly in the flash tank.

Combination process coolers may be divided into two general groups: steam-jet coolers with external exchangers, and those with internal exchangers. In the case of the former, the refrigerated water is circulated from the cold tank, or flash tank, through the exchanger and thence back to the cold tank to be recooled. The design of commercial exchangers is such that the inlet temperature of the cold medium is about 5 deg. F. colder than the outlet temperature of the hot medium. Closer temperatures can be attained, but they usually result in exchanger sizes so large as to be prohibitive.

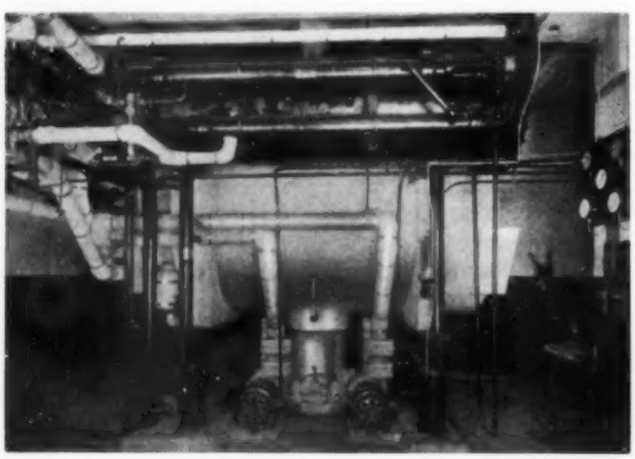
For comparison of the two types of process cooler, a normal problem has been assumed: It is required to cool 30,000 lb. per hour (about 60 g.p.m.) of a solution of specific heat 1.0 from 65 deg. F. to 55 deg. F., using a steam-jet refrigeration unit with an external exchanger. The capacity required $= 30{,}000 \times 10 = 300{,}000$ B.t.u. per hour $= \dfrac{300{,}000 \times 24}{288{,}000} = 25$ tons of refrigeration per day (1 ton of refrigeration is equivalent to the heat required to melt 1 ton [2,000 lb.] of pure solid ice to water at 32 deg. F., or 288,000 B.t.u. per 24 hours). In order to keep the size of the exchanger within limits, assume an operating temperature of 50 deg. F.

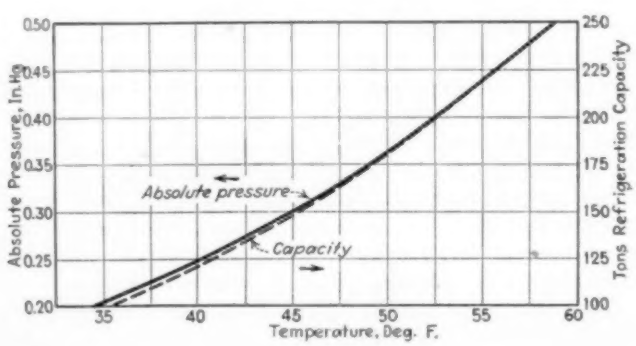
For a well-designed commercial unit the steam consumption of the booster ejectors at 125 lb. gage pressure is about 600 lb. per hour. For the exchanger with a 10-deg. rise, 30,000 lb. per hour of cold water will be circulated. The entering temperature on the hot side will be 65 deg. F. and the leaving temperature, 55 deg. On the cold side the corresponding temperatures will be 50 and 60 deg. F. The mean temperature difference will then be 5 deg. F. With an average heat-transfer rate of 240 B.t.u./hr./sq.ft./deg. F., the surface required in the exchanger will be $300{,}000/240 \times 5 = 250$ sq.ft.

For the pump to circulate 60 g.p.m. of water through the exchanger a 1-hp. motor will be required.

The cost of operating for 5,000 hours (average for 1 year) with a steam cost of 40c. per 1,000 lb. and 2c. per kw.-hr. for pumping will be:

$$\text{Steam} = \frac{600 \times 5{,}000 \times 0.40}{1{,}000} = \$1{,}200.00$$





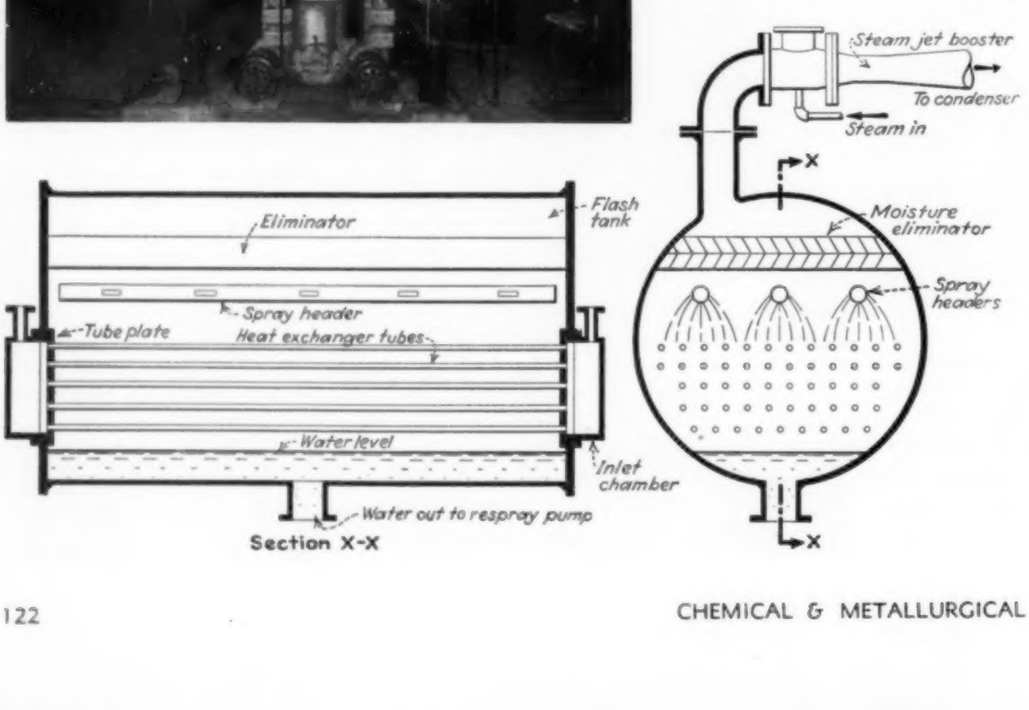


Fig. 1, Upper Left—Steam-jet cooler installation with internal heat exchanger

Fig. 2, Lower Left—Construction of flash tank with internal heat exchanger, shown diagrammatically

Fig. 3, Above—Capacity and absolute pressure of steam-jet units plotted against water temperature

$$\text{Pumping} = \frac{1.0 \times 5{,}000 \times 746 \times 0.02}{1{,}000} = \quad 74.60$$

Total $1,274.60

In a steam-jet cooler with internal exchanger, as shown in Figs. 1 and 2, the liquid to be cooled is circulated through the tubes. A thin film of water is continuously circulated over the exterior surfaces of the tubes by means of a specially designed distribution header. The booster ejector maintains a constant absolute pressure which in turn means a constant temperature. As soon as the temperature of the water on the outside of the tubes becomes higher a part of the water will evaporate. By this evaporation heat will be absorbed from the body of the water, which in turn will absorb heat from the hot fluid in the tubes.

If the temperature in the cold tank is to be maintained the same as that in the steam-jet cooler with external exchanger, the mean temperature difference will be somewhat higher, thereby necessitating a smaller exchanger. As the exchanger cost is only a small portion of the total cost, very little could be accomplished by reducing its size. The same operating conditions can be maintained on the solution side of the exchanger by reducing the terminal difference, or by increasing the operating temperature of the steam jet.

For the steam jet with internal exchanger the following conditions apply: 25 tons capacity; 250 sq.ft. exchanger surface; and a heat-transfer rate increased by $1\frac{1}{2}$ per cent, or 244 B.t.u./hr./sq.ft./deg. F. Then mean temperature difference = 4.93; or solving for the lesser temperature difference (l.t.d.) in the following equation

$$\text{M.T.D.} = \frac{\text{g.t.d.} - \text{l.t.d.}}{\log_e \dfrac{\text{g.t.d}}{\text{l.t.d.}}}$$

we find the lesser temperature difference is 1.5 deg. F. Hence, steam-jet operation temperature is 53.5 deg. F.

In a well-designed commercial unit the capacity should be approximately in the direct ratio of the absolute pressures maintained in the cold tank. Fig. 3 shows the performance characteristic of such a well-designed unit.

Conversely, with a constant capacity, the steam consumption should vary inversely with the ratio of absolute pressures. This ratio is borne out by guarantees on a well-designed commercial unit showing a steam consumption of 550 lb. per hour of 125-lb. gage steam.

The pumping power required on the small circulating pump will be 0.04 hp. The various elements of cost of operation will be:

$$\text{Steam (5,000 hours)} = \frac{5{,}000 \times 550 \times 0.40}{1{,}000} = \$1{,}100$$

$$\text{Pumping} = \frac{5{,}000 \times 0.04 \times 746 \times 0.02}{1{,}000} = \quad 3$$

Total cost of operating = $1,103

Annual saving = $1,274.60 — 1,103.00 = $ 171.60

In addition to this annual saving, the first cost of the steam-jet unit with internal exchanger will be about 5 per cent less than the combined cost of a steam-jet cooler and external exchanger.

Synthetic Resins Now Made From Petroleum

By A. D. CAMP

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THE synthetic resin derived from petroleum hydrocarbons, produced by Monsanto Petroleum Chemicals, is closely related to the gums, which have become such a nuisance to the producers of cracked petroleum gasolines. The problem of their production, however, has been the reverse of that of eliminating of gum formation in gasoline, since means have been sought to accelerate rather than retard the formation of the resinous material. The result of this research has lead to the production of a new synthetic resin.

The process of manufacture of petroleum resins consists in treating a cracked distillate containing hydrocarbons of varying degrees of unsaturation, such as olefines and diolefines, in the presence of a metallic halide catalyst under carefully controlled conditions. The reactions involved are many and complex, probably including the reaction of olefines to form oily polymers, reaction of olefines to produce substituted aromatics, polymerization of diolefines and olefines to resins and reaction of diolefines with substituted aromatics to form resins. By modifying the conditions of treatment, the properties of the resultant resins can be varied widely.

One of the principal commercial uses of these resins has been in the paint and varnish industry. For example, a resin for varnish formulation may be produced having a light amber color. It is a hard brittle material having a melting point, by the ball and ring method, of 110–115 deg. C. It is soluble in practically all hydrocarbon solvents, and insoluble in methanol, ethyl alcohol, and acetone. It also dissolves in the higher acetates, but not in ethyl acetate. The resin is readily soluble in drying oils such as linseed and china wood oil, and with the latter it makes varnishes which dry more rapidly than those made with any type of resin heretofore known. A varnish film of this composition has the tendency to bleach or become light upon drying, which facilitates the use of light-colored pigments without later turning yellow. The resin is practically neutral, having an acid value of 0.1 to 2. The iodine value can be varied to bring out unusual characteristics. When a film made by dissolving a highly unsaturated resin in petroleum spirits is baked for one hour at 105 deg. C., the film becomes insoluble in its original solvents.

In the molded plastics field, petroleum resins have been used to some extent by compounding them with certain fillers and plasticizers. Used alone with fillers, these resins are classed a high melting point thermoplastics, but when compounded with certain hardening agents, they take a permanent set during molding like the phenol-formaldehyde resins. They have been used for the fabrication of steering wheels, tool handles, electrical fixtures, and many articles to which molding resin mixtures are now being applied.

Coordinating Research With Practical Mill Operation

By K. A. TAYLOR
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WHILE any management will always try to build up the type of technical organization which can sell its services to the practical operators, there undoubtedly are not enough technical men of this type available to fill the key positions in the various technical organizations in the industry. Under these conditions management cannot afford to let the burden of coordination rest entirely on the shoulders of the technical man but must accept its own responsibility in this connection.

As a matter of fact, if we look at the whole matter from the viewpoint of the owners or stockholders of any company, the whole responsibility for coordination rests on the shoulders of management. If technical control, research or development work when well organized and properly coordinated with operation, results in substantially increased profits, as the experience of some of the most successful industrial organizations appears to establish beyond the possibility of reasonable doubt, then the management is obviously under obligation to make use of these facilities and provide for their coordination.

While no one would deny this as an abstract principle, in practice, in many cases, management has become discouraged after one or two unsuccessful attempts at utilizing the technical tools available and has either come to doubt the value of technical work or has limited it to the minimum of testing work with possibly one or two men who have proven their ability to secure cooperation from the practical operators kept on for trouble-shooting purposes. This condition, which obviously limits the employment of the technical man's services is due mainly to the three following factors: (1) the limitations of the technical man in selling his services to the operating staff; (2) the fact that operators, even though they may have become sold on the value of one or two technical men have never been sold on the value of technical work as a whole, and (3) the lack of experience of management in properly coordinating technical activities with practical mill operation.

The purpose of the present paper is merely to open up the subject in the expectation that from the criticisms and suggestions which it may bring forth a fairly standard practice may eventually develop. If the recommendation of such a standard practice results in an increased value of the technical man to the industry, then not only will the industry benefit but there will be an increased demand for the technical man's services.

Different types of technical work present different problems of coordination. Before going into the details of coordination, it may, therefore, be well to classify the various activities which management may request a technical organization to undertake. The following classification is one which we have found useful.

I. Routine Testing and Control

UNDER this heading is included:

(1) Routine testing of raw materials, materials in process and finished product,

(2) The maintenance of indicating and recording instruments, meters, etc., throughout the plant,

(3) The supplying of standards and testing information during operation,

(4) The reporting of information on routine operation to the management,

(5) The use of the control department as a central source of information on present and past operation.

II. Sales Development Work

THE objective of work under this heading is to manufacture a product of better and more uniform quality, which should automatically result in increased sales. By a product of better quality is meant one which will be more satisfactory to the customer. Under this heading of sales development work is included:

(1) Study of customers' requirements and translation of these into numerical values for important physical properties which are written into the specifications,

(2) Development of new methods of evaluating important properties of the finished product where these are not available or of improved methods where available methods are unsatisfactory,

(3) Specific work on improvement of grades to more satisfactorily meet customers' requirements,

(4) Delineation of operating variables for each process and study of the relation of these to quality of processed material or finished product,

(5) Study of the relationship between quality of raw materials and materials in process and the quality of finished product and the establishment of specifications for these,

(6) Development of new or improved methods of evaluation for raw materials and materials in process,

(7) Development of rapid methods for routine testing, including indicating or recording instruments where

Based on paper presented before the New York meeting of T.A.P.P.I., Feb. 20, 1934.

possible for indicating or recording the values of the more important properties,

(8) Development of indicating and recording instruments for indicating and recording values for important process variables where such instruments are not already available,

(9) Development of automatic controls for adjusting process variables to automatically control quality of processed materials or finished product where such automatic controls are not already available,

(10) Development of new grades not radically enough different from regular grades to be considered as new products,

(11) Study of operating troubles and nuisances (such as slime, dirt, curl, etc.) which tend to cause non-uniformity of quality and result in customers' complaints or rejections.

III. Cost Reduction Work

ANY work on existing processes which has for its objective a reduction in the final cost of product as delivered to the customer comes under this heading. Examples are work on less expensive raw materials, decreased usage of expensive raw materials or of power, steam, and the like.

Some of the work already outlined under sales development work might also legitimately be included under cost reduction work, since improvement of quality or uniformity or elimination of operating troubles and nuisances will reduce the amount of lost production time and the amount of production of unsaleable product. Such a borderline piece of work will be classified under sales development work or cost reduction work, depending on whether the main objective is increased customer satisfaction or decreased cost.

IV. New Sources of Profit

WORK on new processes, new products, royalties and byproduct recovery and utilization is included under this heading.

Problems of Coordination

In line with what has already been said the problems of coordination are considered solely from the viewpoint of management. In broad outline these problems can be stated simply.

The first and most fundamental problem lies in the attitude of management itself. If management has only a half-hearted belief in the value of technical work it can hardly expect the whole-hearted cooperation of the operating staff in coordinating a technical program with practical mill operation.

The second problem involves selling superintendents and through them foremen and operators the idea that technical work can be of tangible value both to them and to management.

The third problem involves the selecting and organizing of a technical staff which will combine technical ability with the ability to appreciate the problems and viewpoint of management, operating superintendents and operators.

The fourth problem involves the organizing of the technical and operating staffs to work harmoniously towards the same objectives.

The fifth problem which is not strictly a problem of coordination, but which is essential to the continuance of smooth coordination, is the planning and carrying out of the technical program in such a way that it will yield tangible results the value of which cannot be questioned.

The solution of these five problems is essential to the completely successful coordination of technical activities with practical mill operation and obviously any management which has found the solution to these problems has little further to worry about with respect to coordination.

Recommended Practice for Coordination

A management faced with the problem of coordinating technical control, research or development with mill operation should consider the problems just outlined in approximately the order given.

(1) Attitude of Management—If a management is thoroughly sold on the value of technical work when properly coordinated with operation this problem is already solved. If, however, the management is still somewhat skeptical the first step is to thoroughly convince themselves one way or the other. In this case a careful study of the classification of technical work already given may be of help. In going over this classification some of the classes of work listed may appear to be of doubtful value for application to immediate problems. These classes should be avoided at least at the beginning of the program.

If a management can find nothing in this list which it believes to be of potential value when applied to their own problems it might as well forget technical work for the time being, since a technical program entered into in this frame of mind is almost certain to be a waste of money. If some of the classes of work appear to be of potential value but management is still skeptical of their being carried out successfully to yield results of tangible value, the next step is to study the experience of mills which have already realized tangible results from these classes of work and become thoroughly convinced that the securing of valuable results is entirely a matter of properly carrying out the technical program. Once management has sold itself on the results which it is possible to obtain it is ready for the next problem.

(2) Selling Operators on Value of Technical Work—This is perhaps the most difficult step in the whole coordination program and is well worth the expenditure of considerable planning, effort and time. The careful selection of the first work to be undertaken, particularly with respect to the objectives of the work, is again an important factor. Most superintendents hold their positions because of qualities of ability and leadership well above the average and if properly approached will readily realize the potential value of certain types of technical work.

The various steps in the selling process are the same as those used consciously or unconsciously by any successful salesman.

(a) *Securing Attention*—This is no problem for management although it might be a serious stumbling block for the technical man if not backed by management. This is another strong reason for the management and not the technical man carrying out the selling program.

(b) *Creating Interest*—This can be done by pointing out the results which other organizations have accomplished by technical work.

(c) *Arousing Desire*—This can be done by pointing out numerous cases where technical work might help the operating superintendents with some of their own problems. The selection of the first problems to be turned over to the technical staff is again of great importance here. It should not be difficult to sell the value of work which the operating man feels will improve the quality or uniformity of his product, decrease his operating costs or eliminate some operating trouble or nuisance. On the other hand, he is liable to be very skeptical of the value of development work on any new processes which would involve drastic changes over present practice, well knowing the operating grief which is liable to occur in the first stages of operation of a new process and the unforeseen difficulties which may turn up in operation to make the process impracticable. It seems axiomatic that the value of technical work should be thoroughly established against a background of successful results in improving quality and reducing costs before the more difficult proposition of selling development work on new processes should be attempted. Development work on a new process which would be a failure if attempted without the whole-hearted cooperation of the operating superintendents may be a complete success if carried out later with their enthusiastic cooperation.

(d) *Securing a Trial*—Once the operating superintendents have become interested in the potential value of certain kinds of technical work and want to see them tried out it should not be difficult to get them to suggest that work be carried out to supply them with some definite pieces of information or provide some definite testing service. At least most of these suggestions can then be worked into the management's own program when it is started.

(e) *Establishing Confidence*—The selection and planning of the first pieces of technical work to be carried out, and the selection of the technical men to carry them out are very important factors in establishing confidence. It is essential that the first work carried out results in some definite tangible value to the operating superintendents which they can see and appreciate and which will convince them that they can utilize the technical man's services in the solution of more of their problems. Work which will fulfill these requirements should be selected for the first part of the program even if other work which has greater potential value but which does not fulfill these requirements has to wait until later in the program.

In proposing or planning any technical work it is wise to avoid even the appearance of the work being used as a check on the operating superintendents for the benefit of management. This applies especially to testing and control work. The widespread use of the term "control" is perhaps unfortunate since it implies in itself such a check.

The responsibility given to control or testing departments varies with different mills. In some cases they have the authority to pass or reject finished product on the basis of their results. In other cases they merely supply information to the operators and management. There may be advantages for both methods, but, from the standpoint of coordination, the second method is much better. The operating superintendents still retain full responsibility for the quality of product and the testing information becomes a valuable help in making decisions.

So far we have stressed mainly the selling of technical work to the operating superintendents. Once they have confidence in the program the selling of the foremen and practical operators should present little difficulty if the superintendents have the qualities of ability and leadership which usually go with their positions.

Once confidence has been established there is some danger that the technical program may be swamped with investigations of minor operating difficulties to the exclusion of broader investigations of more potential value. This is another reason why the program should be in the hands of the management who should have a broad perspective of the company's problems and who can guide the trend of the work into more profitable channels without losing any of the confidence which has been established.

(3) ORGANIZING OF TECHNICAL STAFF—This problem is one which we cannot do justice to here without making this paper too long drawn out. For a large organization it is best to select a technical director of proven ability and put the problems up to him. He can then select the technical men he requires and organize the program along technically correct lines. Every effort should be made to avoid getting any men into the organization, especially in the key positions, who do not appreciate the viewpoint of the operators and have not the tact to get along well with them. This point of view should be impressed on the technical men when they are taken on.

(4) ORGANIZING STAFFS TO WORK TOGETHER—This should not be difficult if the preliminary work has been well done. At this point the technical men and the operating men should have similar viewpoints regarding the work to be carried out and its objectives. They should now get together periodically with the management present and go over the plan of attack on each problem. Results can also be discussed periodically as the work progresses. In this way the management can see how well coordination has been effected and, if there are any weak links in the chain, take steps to correct these.

(5) PLANNING TECHNICAL PROGRAM—This is beyond the scope of the present discussion and has only been included because it will greatly influence the degree of confidence which the superintendents and practical operators will continue to have in the value of technical work. If negative or unsuccessful results are continually obtained it will be impossible to maintain the same degree of confidence in the program.

Once management has paved the way for smooth coordination and has selected certain problems to be attacked, the technical organization must stand or fall on the results it obtains. Problems which are too difficult for early solution should not be attempted in the first stages of a technical program but if the general quality of results on carefully selected problems does not justify normal expectations, then there is obviously something wrong with the technical organization and it should be weeded out and reorganized rather than allow it to continue to function unsuccessfully and lose the ground which has already been gained.

Adsorption, Refrigeration and Compression For the Drying of Gases

By J. H. PERRY and H. C. DUUS

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Editor's Note: This is the second of two articles on the drying of gases prepared by the authors. The first, appearing on pages 74-7 of our February number, dealt with the drying of gases by absorption.

As IS well known, a number of highly active adsorbents, such as charcoal, silica gel, alumina gel, and many other hydrated oxides and porous substances, are capable of adsorbing considerable quantities of vapors. While this process is usually designated as adsorption, to distinguish it from physical or chemical absorption, there is no fundamental difference in the overall effect as regards the desiccation of gases. These adsorbents will often reduce the moisture content of gases to surprisingly low values. Johnson (*J. Am. Chem. Soc.*, Vol. 34, 1912, p. 911) states that 1 gram of Al_2O_3, prepared by igniting the hydroxide at low temperatures, will remove practically all the water from 10 liters of air saturated at room temperature, and is surpassed only by P_2O_5 as a drying agent. (*Cf.* Table II, first article of this series, p. 75, Feb., 1934.) It may be regenerated an indefinite number of times by heating it with a smoky flame while dry air or other inert gas is being passed therethrough.

Well-dried textile fibers, such as cotton, wool, silk or rayon, will remove 97-99 per cent of the moisture in air at 20 deg. C. and such drying agents may be freed of all but a few tenths of a per cent of adsorbed moisture by heating in an air stream at 100 deg. C. (Obermiller, *Z. Physik. Chem.*, Vol. 109, 1924, p. 145). This method of drying was used by Lord Rayleigh during his epoch making work on the density of nitrogen when he hung a woolen blanket in his balance room, which often absorbed as much as 2 lb. of water in 24 hours. Previously the method had been used by Maxwell. (See Rayleigh, "Life of Lord Rayleigh," p. 162, Longmans Green & Co., 1924).

One of the most important adsorbents for the drying of gases is silica gel, the properties of which are described in an article by E. B. Miller (*Chem. & Met.*, Vol. 23, 1920, pp. 1155, 1219, 1251). A large blast-furnace installation, using a silica gel adsorbent, has apparently proved satisfactory (Lewis, *Engineering*, Vol. 124, 1927, p. 853); six adsorber units are used, each 17 ft. high, and charged with 6 tons of silica gel in granular form which will adsorb from 30 to 50 per cent of its weight of water. The spent gel is regenerated by heating to 640 deg. F. with waste blast-furnace gas for 1½ hours. The capacity of this plant is 35,000 cu. ft. of air per minute. Experiments at Edgewood Arsenal (*Chem. & Met.*, Vol. 28, 1923, p. 805) have indicated that the adsorption efficiency of silica gel decreases slightly with continued reactivation as might be expected, but the gel itself suffers no physical disintegration (crumbling of the granules).

An interesting application of silica gel is its use in drying cylinder oxygen (Krull, *Z. komprimierte und flüssige Gase*, Vol. 30, 1933, p. 1). Two electrically-heated adsorbers are set up in parallel and charged with gel, one being regenerated by nitrogen while the other is in operation. One unit will dry 15,000 cu. m. of oxygen down to a moisture content of 10 mg. H_2O per cu. m.

Activated alumina has recently been developed to a point where it finds commercial application. It is claimed to dry with 100 per cent efficiency until an increase of weight of 12-14 per cent is attained; and at lower efficiencies up to a weight increase of 20-25 per cent. (*Ind. Eng. Chem. News Ed.*, Vol. 2, 1933, p. 199).

Drying by Refrigeration

Drying of a gas by refrigeration is accomplished by lowering the vapor pressure of water. The great effectiveness of the refrigeration method of drying gases is indicated by Table I, which gives the vapor pressure of water at several temperatures.

If a gas is saturated at 20 deg. C., and is then cooled to —50 deg. C., a temperature easily obtained with solid carbon dioxide, it is seen that the moisture removed will be:

$$\frac{17.535 - 0.0295}{17.535} \times 100 = 99.26 \text{ per cent}$$

of that originally present. If, however, refrigeration is combined with compression the amount of water removed is even more pronounced; for example, if the refrigeration indicated above had been combined with compression to 10 atm., 90 per cent of the residual moisture, $0.9 \times 0.0295 = 0.0266$, would have been removed. It is therefore evident that moisture elimination is greatly increased when both refrigeration and compression are used.

When low temperatures are used for the drying of gases in ordinary laboratory work, it may happen that the sudden cooling produces an ice fog which is not easily precipitated on the walls of the trap (Bircumshaw, *J. Chem. Soc.*, 1930, p. 2213). This formation of fog (small particles of liquid water and/or ice) is undoubt-

Table I—Vapor Pressures of Water*

Temperature, Deg. C.	Pressure, Mm. Hg	Temperature, Deg. C.	Pressure, Mm. Hg
20	17.535	—40	0.0966
10	9.209	—50	0.0295
0	4.579	—60	0.00808
—10	1.950	—70	0.00194
—20	0.776	—80	0.00040
—30	0.285	—90	0.00007

*From "International Critical Tables," Vol. 3, p. 210.

Table II—Power Requirements for Cooling Illuminating Gas

(Horsepower-hours per M cu.ft. gas)

Initial Temp., Deg. F.	Cooled to 30 Deg. F. Hp.-Hr.	Cooled to 30 Deg. F. Per Cent H_2O Cond.	Cooled to 40 Deg. F. Hp.-Hr.	Cooled to 40 Deg. F. Per Cent H_2O Cond.
110	1.05	93.5	0.82	90
100	0.67	91.5	0.54	87
90	0.45	88	0.35	82
80	0.27	84	0.19	76
70	0.16	77	0.10	66
60	0.09	69	0.05	54

Table III—Power Requirements for Cooling Gases by Compression

(Using single-stage compression)

Pressure, Lb. per Sq. In. Absolute Initial	Final	Power, Hp.-Hr. Per M Cu.Ft.	Relative Humidity,* Per Cent
14.7	29.4	0.83	50
14.7	44.1	1.33	33
14.7	58.8	1.77	25
14.7	73.5	2.14	20

*When expanded to original temperature and pressure.

edly due to the rapidity of the cooling; if the cooling is less rapid, the formation of such a difficultly precipitable fog mist is largely obviated.

When mechanical refrigeration is used for drying, the power requirements are an important item since a great deal of heat must be extracted from the gas. Table II, based on the data of Speer (*Am. Gas Assoc. Proc.*, 1926, p. 1250), gives the horsepower-hours required per 1,000 cu. ft. per hour to cool city illuminating gas. These data are approximately correct for all other gases. The column of the table giving the percentage of moisture condensed from the gas is calculated with the assumption that the gas is saturated at the initial temperature.

Isothermal Compression and Expansion

Drying gases by compression is not accomplished by an actual reduction of the vapor pressure of water, although compression alone (without subsequent expansion) may be used to dry gases. Thus, if a gas saturated with water vapor at 1 atm. pressure be compressed to 10 atm., the total volume will be reduced to (approximately) one-tenth of the original volume and all but (approximately) one-tenth of the original water content will be condensed. If provision is made to remove such condensed water before expansion to 1 atm., the gas will have been reduced to a relative humidity of 10 per cent. The power required for compression may be conveniently determined by Lucke's graphs (Marks' "Mechanical Engineers' Handbook," p. 1871, 3d Ed., McGraw-Hill), from which Table III has been constructed with the assumptions that (*a*) single-stage compression is used and (*b*) the gas at the initial pressure is completely saturated with water vapor. Multiple-stage compression will require less power consumption than single-stage compression.

The vapor pressure of water is increased by the application of an excess external pressure (the so-called Poynting effect). However, the effect is not pronounced unless a pressure of 50 atm. or more is employed (Bartlett, *J. Am. Chem. Soc.*, Vol. 49, 1927, p. 65), which is much higher than can be justified from an economic standpoint except where such high pressures must be used for other reasons, as in high-pressure catalytic processes. Figs. 1, 2 and 3 (reproduced from Perry's "Chemical Engineers' Handbook") are of interest in showing the effect of pressure upon the amounts of water vapor in a gas.

The effect of pressure on a gas-water system, or more generally any gas-liquid system, is quite complicated. The magnitude of the Poynting effect is derived by the following consideration: Apply an external pressure, dP, to a molal volume of liquid, V_1. The free energy increase per mol is then V_1dP. If we now assume that the vapor can escape from the compressed liquid, through a semi-permeable membrane, and condense at the original pressure there is a free energy decrease exactly equal to the free energy increase caused by the application of pressure. This free energy decrease per molal volume of vapor, V_g, is V_gdp where dp is the increase in vapor pressure due to increase of external pressure. Accordingly we obtain the equation:

$$V_1dP = V_gdp$$

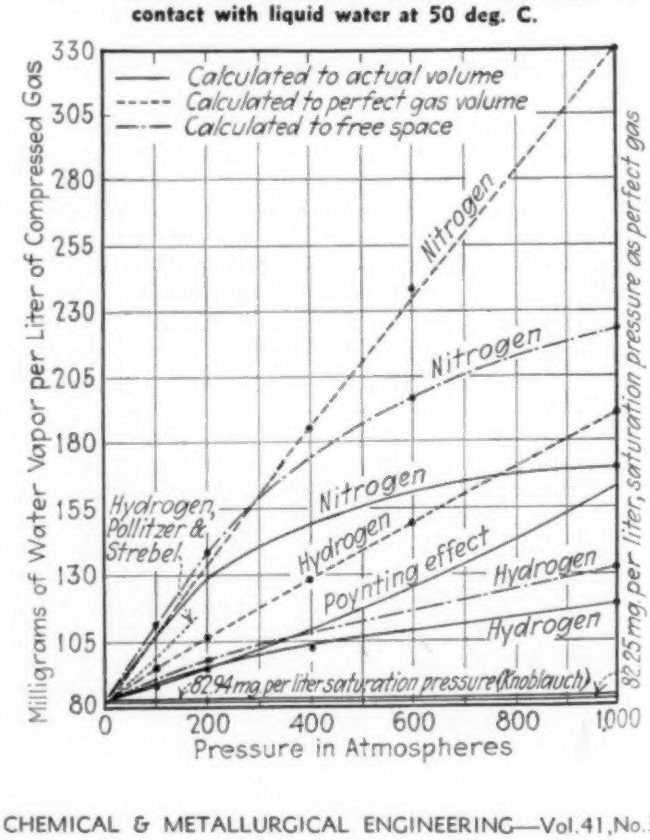
Assuming V_1 independent of P, which is the mathematical equivalent of assuming that the liquid is incompressible, and that $V_g = RT/p$ (the ideal gas law), the above equation may be integrated and we get

$$V_1\ (P_1 - P_2) = RT\ \log_e\ (P_1/P_2) = RT\ 2.303\ \log_{10}\ (P_1/P_2)$$

where P_1 and P_2 are the vapor pressures of the liquid under the external pressures P_1 and P_2. At 0 deg. C. it may be calculated that an increase of the external pressure by 760 mm. will increase the vapor pressure of water from 4.579 mm. to 4.5828 mm.

Actually, this equation should be quite exact since most liquids at temperatures well below the critical are nearly incompressible and the gas laws are very closely obeyed for the small changes in vapor pressure which are involved. However, when an attempt is made to apply the equation to an actual gas-liquid system, the discrepancy between calculated and observed results is quite large (*Cf.* Bartlett, *J. Am. Chem. Soc.*, Vol. 49, 1927, p. 65). This is to be expected because a gas compressed over a liquid does not correspond to the semi-permeable piston assumed in deriving the equation. In the first place the gas is soluble

Fig. 1—Water vapor content of hydrogen and nitrogen in contact with liquid water at 50 deg. C.



to some extent in the liquid, and consequently the vapor pressure should be lowered in accordance with Raoult's law. Since the solubility varies for different gases, the effect would be specific and not general. Partington and Hungerford (*Cf. J. Chem. Soc.*, Vol. 123, 1923, p. 161) have calculated the specific heats and concluded that the vapor pressure lowering by Raoult's law should be less than the vapor pressure increase due to the Poynting effect. Campbell nevertheless finds a vapor pressure of 230 mm. for water under hydrogen; 225.8 mm. for water under air; and 233.8 mm. for pure water at 70 deg. C. (*Trans. Far. Soc.*, Vol. 10, 1915, p. 202).

The second consideration is that the degree of association of water vapor is assumed constant in deriving the Poynting equation, but in the presence of a large amount of inert gas this is probably not the case. Applying the phase rule, we see that a two-component system is divariant when two phases are present. Consequently, in order to define accurately the partial vapor pressure of such a system we must specify not merely the temperature but also the relative quantities of the two components. Marked deviations from Poynting's law may be expected when the gas in question is very near its critical temperature, as for example carbon dioxide and water at room temperature,. A mathematical analysis of the problem is beyond the scope of this paper but those who may care to pursue this rather fascinating subject further are advised to consult Bartlett's experimental data and their theoretical interpretation by Van Laar (*Z. physik. Chem.*, Abt. A, Vol. 145, 1929, p. 207). Studies are also being carried out at the University of Illinois on the deviations of the nitrogen water system from the requirements of the Poynting equation (*Ind. Eng. Chem. News Ed.*, Vol. 2, 1933, p. 160).

Fig. 2—Water vapor content of compressed gases in contact with liquid water at 25, 37.5 and 50 deg. C.

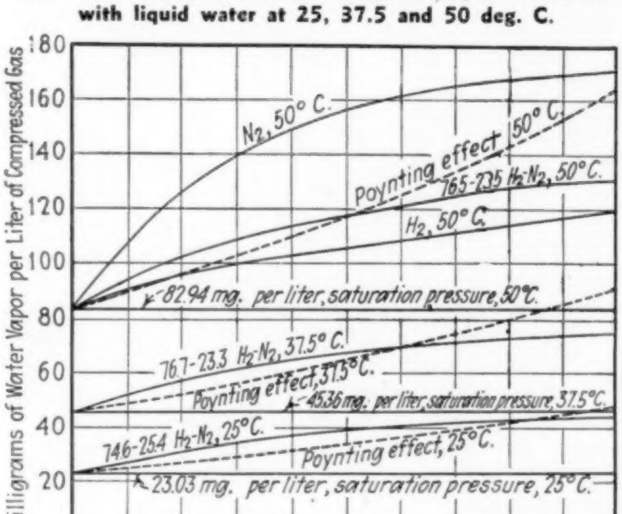
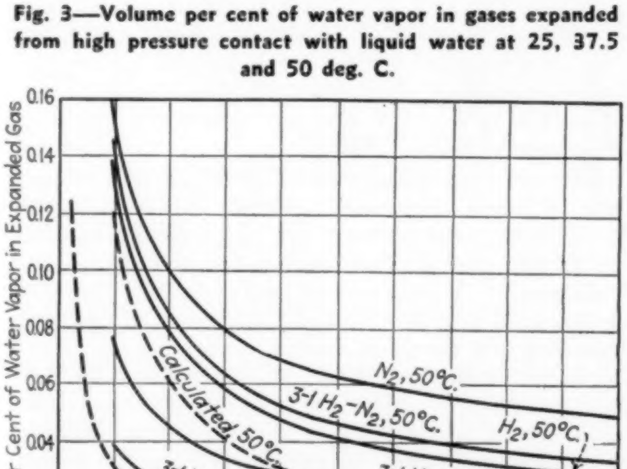


Fig. 3—Volume per cent of water vapor in gases expanded from high pressure contact with liquid water at 25, 37.5 and 50 deg. C.



Choice of a Drying System

Both the choice of a drying system and the storage of gases, once they are dried, must be given consideration. Although it is impossible to foresee every condition which a drying system should meet, or to specify systems for every problem that is likely to be encountered, a few general principles may well be considered here. It is obvious that no impurities more series than water itself should be introduced. Thus, anhydrous methanol and ethanol are both good drying agents but their use would saturate the gas with their own vapors to a much greater extent than the water which they remove; however, the presence of such vapors may or may not be deleterious in the subsequent process for which the gas is dried. Similarly, the use of a drying agent which would react with the water to generate either a gas or a liquid should be avoided where such a substance is undesirable.

Furthermore, the use of a liquid drying agent may necessitate the use of special (but inexpensive) equipment for the removal of any of the drying agent that may be entrained in the gas. This type of "trapping" equipment is particularly necessary where the dried gas is to be used subsequently in a process involving materials that would be damaged by such entrained drying agent. Similar precautions are necessary of course in the case of solid drying agents that are apt to "dust" and that are similarly injurious in the subsequent process. Typical examples of such materials are: liquid acids and their anhydrides, and liquid and solid alkalis.

Next in importance is the economic consideration. Here convenience in handling the drying agent and a rapid rate of water absorption are desirable. However, the degree of moisture removal should not be carried beyond the minimum which can be tolerated, since further removal of water will demand larger quantities of drying agent and greater energy expenditure in accomplishing the regeneration.

The cost of drying city gas has been estimated by Bragg (*Chem. & Met.*, Vol. 35, 1928, p. 731) for three cases: (1) $CaCl_2$ brine, (2) refrigeration and (3) compression. He gives the following data per 1,000 cu. ft. of gas processed: (1) \$0.0371; (2) \$0.0090 to \$0.0113; and (3) \$0.006. The low cost for drying by compression is due, however, to some credit given for the power necessary to distribute the gas, which could probably not be realized in a strictly chemical operation. In both compression and refrigeration, power is expended on the gas itself. In drying by adsorption or absorption no power is expended on the gas although power is used in the regeneration processes. Where the cost of power is high, adsorption or absorption processes would seem to possess some advantages. However, all gas-drying problems should be considered individually inasmuch as local conditions will greatly affect the process chosen.

Finally, there is the question of the storage of the dried gases. Water-sealed holders are doubtless the cheapest, but it is obvious that the storage of dried gas in such a holder will defeat the purpose of the drying operation. Similarly, the use of certain other liquid sealing materials, as mineral oils, etc., will ultimately permit the entrance of moisture to the dry gas in such holders by the slow diffusion of water vapor through the liquid seal.

Gaskets for Pressure Vessels and Heat Exchangers

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Editor's Note—This article supplements a group of three papers on heads, bolts and flanges for pressure vessels written by Mr. Sandstrom for our issues of December, 1932, and February and March, 1933.

A LEAK between the flanges of a pressure vessel or pipe line may, depending on its extent, completely nullify the purpose of the apparatus. Yet the cost of a gasket is so trifling compared with that of the flanges it serves that one is apt to recall the story in the school reader of the kingdom that was lost for the want of a horseshoe nail. The gasket is an item of such apparent insignificance that men who are too important to be interested in "details" are likely to delegate its selection and application to one who makes up joints in the prideful knowledge that he can screw up the nut on a flange bolt a full turn more than any other member of the gang. Much of engineering design must therefore have as one of its objectives the production of "foolproof" apparatus, although it might be cheaper in the long run to eliminate the fools.

Joints in pressure vessels may be made up with gaskets and packing of various materials. Rubber is the most common, with asbestos mixed with this and other materials probably second in extent of use. Other non-metals are paper (plain and shellacked), canvas or duck, hemp, flax, felt, leather and cork, with graphite as an auxiliary material. Of metals we have steel, copper, Monel, aluminum and lead, with mixtures or alloys of these and other metals. Copper-plated steel is also used. Combinations of the metals with the non-metals are found in the "insertion" and metal-sheathed gaskets. Corrugated gaskets with and without other materials are also common.

The choice of a gasket depends somewhat on the pressure of the fluid but, to a greater extent, on its temperature and chemical properties. A gasket may be suitable for the pressure and temperature, yet be incapable of resisting the solvent action of the fluid. Or it may be able to resist the solvent or the corrosive action of the fluid, and fail under high temperature.

The purpose of a gasket is to compensate imperfections in the faces of the flanges, which implies that its use is not necessarily imperative, since the desired result can be obtained without it by means of smooth contact surfaces. Ground surfaces have their limitations, however, so gaskets have the preference in the scheme of fluid-tight joints.

Ground joints have flat, conical, or spherical surfaces, and combinations of these. The spherical surfaces are sometimes made to slightly different radii in order to reduce the width of contact. In many cases, however, the closure is made with separate narrow faced "lenses" held to their seats, as shown in Fig. 1, or cut integral with the cover, or clamping plate.

Another type of joint that eliminates the use of gaskets, and one that has been used successfully in steam-engine practice, is shown in Fig. 2. A tongue turned on the cover bears on the shell or cylinder flange. Ordinary machining suffices for a tight joint; this may be explained by the fact that the face is turned on a boring mill and the surface, while apparently smooth, is, when examined with a magnifying glass, found to have a spiral thread. As the top of the spiral is thin, a high concentration of pressure is produced which prevents leaks.

A metal-to-metal joint for high pressure may be made by cutting concentric grooves in the faces of the flanges. The threads formed by the cutter in one flange fit into the grooves of the other, as shown in Fig. 3. This construction provides a labyrinth in radial directions and insures high pressure between the tops of the threads and their corresponding grooves—both conducive to fluid tightness.

In modern high-pressure, high-temperature steam plants recourse is sometimes had to pipe flanges into the faces of which are cut concentric (or spiral) grooves, $\frac{1}{64}$ in. deep and 32 to the inch, which surface is termed a "phonograph finish," from its resemblance to a flat phonograph record. The thread imbeds itself into the gasket, localizing and increasing the pressure. At the same time it forms a labyrinth which is very effective in preventing leaks.

Gaskets do not "blow out," as water carries away a dam, although they may fail very rapidly by erosion. In order to resist pushing out the gasket from between the flanges, the product of the face pressure and the coefficient of friction need be only one half the product of the fluid pressure and the thickness of the gasket, neglecting the tensile resistance of the gasket. For example, in the case of 250 lb. fluid pressure and a gasket $\frac{1}{16}$ in. thick, the product of the face pressure and the coefficient of friction is $250 \times 0.0625/2 = 7.82$ lb. per sq.in. The coefficient of friction used in the design of brakes and clutches built of cast-iron and asbestos fabric is about 0.35, so if the working conditions of the gasket are the same as those of the brake, the pressure on the face of the gasket need be only $7.28/0.35 = 22.3$ lb. per

sq.in., to prevent bodily displacement. As the face pressure is seldom less than the fluid pressure, and frequently a great deal more, there is always a safe margin against displacement.

There has been some discussion of the correct thickness of gaskets. One argument against the thick gasket is its higher cost. Another is that in the case of non-metals the imperfections of material and manufacture become more evident. On the other hand, the thick gasket can be better used between surfaces that have not had a formal machining; that is, between rolled or pressed surfaces of vessels carrying moderate pressures. I have seen heat exchangers carrying 50 lb. pressure or more that had asbestos fabric gaskets upwards of ¼ in. thick between surfaces that were not machined; and with flanges so thin that the edge of the cover was corrugated by the pull of the bolts. Gaskets between machined surfaces, however, may be quite thin because the irregularities are then slight, and by reducing the thickness there is less danger of distorting the flanges and gasket by careless tightening of the bolts.

Nearly as important as the gasket is the method of tightening the bolts, since carelessness in this particular may nullify the best gasket. The ideal method of tightening the bolts is to tighten them all at once, which, of course, is not practicable; but the nearer one approaches this ideal the less trouble there will be from distorted flanges and gaskets. A practical method of tightening flange bolts is to turn the nuts up to a snug bearing without applying pressure enough to deform either flange or gasket. Then, in the case of small flanges, and with a wrench in each hand, tighten opposite bolts in several operations, moving back and forth as nearly 90 deg. as possible, as indicated by the numerals in *a* of Fig. 4. In the case of large flanges, as on heat exchangers and tanks, two men could be advantageously employed.

If the bolts in a flange are tightened in their order across the face, as in *b*, Fig. 4, the gasket will be compressed at the edge, tilting the opposite side of the flange and making it difficult to seat properly, and sometimes resulting in a deformed flange. If tightened, as indicated in *c*, Fig. 4, the flange is arched in the middle, which arch is seated on the gasket with much difficulty. The last two methods of tightening flange bolts result in very high stresses in flanges and bolts and may cause distortion or fracture.

Gasketless Joints Require Care in Bolting

Care must be exercised in bolting on a cover or flange with ground contact surfaces. Very high concentrations of pressure in the vicinity of the bolts are apt to cause deformation of the surface in spots—which is one of the reasons for gaskets. I know of a case in which ground surfaces were unsuccessfully applied to the closure of a piece of refinery equipment. After a few removals and replacements, the contact surfaces were so marred that pastes and then litharge-and-glycerine were applied to make a tight joint. Later a gasket was found necessary.

Metal-to-metal surfaces of the kind referred to are immune to failure by crushing unless made extremely narrow, or applied to flanges that are over-bolted; that is, having bolts stronger than the flanges. A compressive stress of about 35,000 lb. per sq.in. is the elastic limit of the steel ordinarily used, so if this is not exceeded there will be little danger of failure of the surface, although failure of the flange might occur from excessive transverse stress.

Let us assume a pressure vessel, 48 in. in diameter, to the inside of the asbestos composition gasket, shown in Fig. 5. The width of the gasket is 1.5 in. The working pressure is 250 lb. per sq.in. Obviously the full fluid pressure is exerted to the inner edge of the gasket. The gasket, however, does not immediately bar the fluid but reduces its pressure to zero somewhere across its

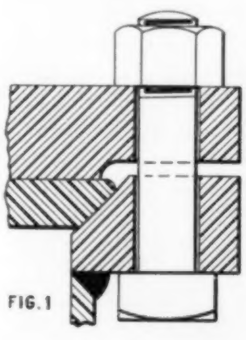


FIG. 1

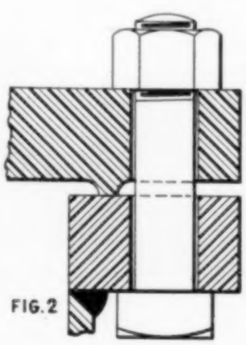


FIG. 2

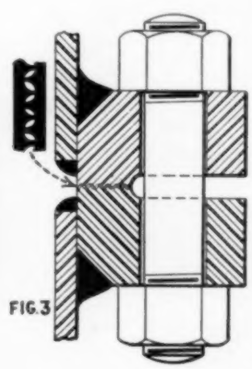


FIG. 3

Fig. 1—"Lens" type ground joint requires no gasket

Fig. 2—Gasketless machined joint employing a narrow tongue

Fig. 3—Grooved metal-to-metal joint for high pressure

FIG. 4

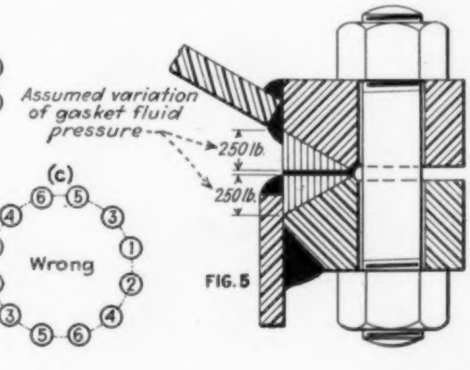


FIG. 5

Fig. 4—One "right" and two "wrong" sequences in tightening pressure-vessel flange bolts

Fig. 5—Assumed distribution of fluid pressure on a gasket face

width. Whatever may be the rate of diminution of the fluid pressure across the face of the gasket, the net effect probably does not exceed that of full pressure at its inner edge to zero at its outer edge, with the pressure variation represented by a triangle. The average fluid pressure on the gasket is then one-half the maximum, or 125 lb. per sq.in. Besides the fluid pressure under the head and under the gasket, the bolts must carry an additional pressure necessary to make the gasket impervious, which pressure is called "final gasket compression," because it is in addition to the portion of the initial gasket compression that equalizes the fluid pressure.

Safety Valve Analogy Indicates Compression

The magnitude of the final gasket compression is a rather uncertain quantity. Some writers have assigned to it values upwards of 20 times the unit fluid pressure, which is, I think, very much in excess of the actual, or at least of the required, pressure. I think the safety valve used on steam boilers can throw some light on the subject.

There are two kinds of seats in the familiar safety valve; flat and 45-deg. bevel, but the virtues of neither need be discussed here. The width and consequently the area of the seat varies with the make of valve, but can be assumed as one-fourth the area of the port. When the predetermined steam pressure in the boiler is reached, the valve opens slightly, permitting steam to escape. A slight increase in the lift of the valve permits the escape of a larger volume of steam and, due to its peculiar construction, the valve suddenly opens, producing the characteristic "pop" that gives the valve its name.

Safety valves open with an increase of less than 1 lb. above the working pressure so, if the area of the valve seat is one-fourth the area of the port, the bearing pressure, or what is equivalent to the "final gasket compression" discussed in the foregoing, is less than 4 lb. per sq.in. If the final gasket compression were several times the fluid pressure, then, in the case of a steam boiler operating at 200 lb. per sq.in., the pressure required to lift the valve would be 50 lb. for each unit working pressure. For example, if the "final gasket compression" is four times the unit working pressure, then the safety valve on a boiler under a working pressure of 200 lb. per sq.in. would not open until the pressure reached 400 lb. Obviously such a valve would not be a "safety" valve.

The method of loading the safety valve is practically ideal, and for that reason is not exactly comparable with the bearing surfaces of the flanges of pressure vessels. But I believe that a reasonable allowance for the final gasket compression is unit working pressure, which is a convenient allowance in that the full fluid pressure may then be regarded as acting over the area bounded by the outer circumference of the gasket. Then with the addition of one-half the unit fluid pressure acting on the area of the gasket, but assumed as concentrated on a circle passing through the inside of the middle third, the work of designing head and flanges is simplified.

To summarize then, the initial pressure on the gasket of the 48-in. pressure vessel assumed in the foregoing is the fluid pressure over a circle of 51-in. diameter, or $51^2 \pi\, 250/4 = 510{,}700$ lb.; plus $(2{,}043 - 1{,}810)\ 125 = 29{,}150$, or a total of 539,850 lb. Dividing by the area of the gasket we have a unit pressure of 2,320 lb. per sq.in. on the gasket.

Before the fluid pressure is applied, the total pressure as indicated above is carried by the gasket and, of course, by the bolts. When the fluid pressure is applied, the pressure on the gasket is relieved and the remaining pressure is that designated "final gasket compression," or 250 lb. per sq.in.; assuming, of course, that the gasket does not produce an elastic effect as discussed later.

Except in the case of small flanges where the assumed final gasket compression is a large part of the total load carried by the flanges and bolts, the assumption of several times the unit pressure will have small effect on design. So, for a steel gasket the width of which is, say, one-fourth the width of the asbestos gasket of the foregoing example, it would matter little if four or more times the unit fluid pressure were assumed for the final gasket compression. What is more important is to understand that bolts of flanges having gaskets lying entirely inside the bolt circle are under high transverse stress due to eccentric loading and should be designed accordingly.

Occasionally we meet with the impression that gaskets can be reduced in thickness appreciably by the compressive force of the flanges. In fact, I once saw provision made in a piping layout for the compression of asbestos composition gaskets from $\frac{1}{16}$ in. to $\frac{1}{32}$ in. Of course, any such treatment would result in a lot of gasket material oozing out from between the flanges. An idea of the resistance of thin gasket material may be had by squeezing a piece, say one inch wide, of ordinary rubber sheet packing between the jaws of a machinist's vise.

Crushing Resistance of Gaskets Unimportant

The thinner the material of which a gasket is composed, the greater its resistance to flow, until a thickness is reached that will sustain, without perceptible deformation, a pressure exceeding the ultimate strength of the material as ordinarily determined. This statement should not be confused with evidence, frequently found, of gaskets made thin at their outer edges by the dishing of the flanges. The ratio of width to thickness of gasket that manifests the foregoing property is on the order of 16 for copper and considerably less for steel. Resistance to crushing is therefore not an important consideration in the design of a flat gasket, although its elastic behavior, that is, its ability to return to its original dimensions, may be of considerable importance.

If gaskets invariably manifested the ordinary stress-strain relation of materials, then flanges and bolts would have to be designed for far greater loads than outlined in a former paragraph. For example, before the fluid pressure is applied the gasket is subjected to compression equal to the tension in the bolts. Now, if the gasket complied with the stress-strain property of materials it would be deformed slightly, but the deformation would disappear on removal of the tension in the bolts. The gasket may then be regarded as of the nature of a compression spring carrying a load equal to that in the bolts which, in turn, may be regarded as tension springs; the load being, as stated in the foregoing, the fluid pressure under the cover and under the gasket, and the "final gasket compression," or the pressure necessary to make the gasket impervious to the fluid.

If now the fluid pressure is applied, the pressure on the gasket is decreased and the tension in the bolts increased by the amount of the fluid pressure under the head and the gasket, resulting in nearly doubling the stress in bolts and flanges. It is clear that with a gasket narrow enough to behave as an elastic member under load, the stresses in bolts and flanges are the sum of the initial, or tightening stresses, and the stresses incident to the fluid pressure.

Wide Gaskets Resist Elastic Deformation

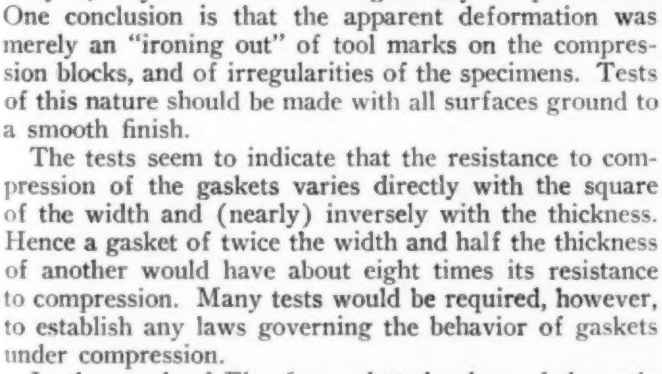
The elastic effect of gaskets is seldom obtained, however. Generally the gasket is so wide that it resists deformation altogether by reason of the lateral restraint produced by friction of the surfaces, or is so narrow —wires for instance—that the deformation far exceeds the elastic limit. If the apparent stresses in bolt and gasket are to be equal, then the required width of the gasket is the sectional area of the bolt at the root of the thread divided by the length of gasket per bolt. For example, the width of a gasket in flanges held by 1-in. bolts, each of which serves a 3-in. length of gasket, is $0.55/3 = 0.183$ in.

The few tests of the compressibility of gasket material that I know of produced some rather anomalous results. At comparatively low pressures the apparent deformation of the material was so great as to make the ratio of stress to deformation, or the modulus of elasticity E, only a fraction of the generally accepted value. One conclusion is that the apparent deformation was merely an "ironing out" of tool marks on the compression blocks, and of irregularities of the specimens. Tests of this nature should be made with all surfaces ground to a smooth finish.

The tests seem to indicate that the resistance to compression of the gaskets varies directly with the square of the width and (nearly) inversely with the thickness. Hence a gasket of twice the width and half the thickness of another would have about eight times its resistance to compression. Many tests would be required, however, to establish any laws governing the behavior of gaskets under compression.

In the graph of Fig. 6 are plotted values of the ratio of width²-to-thickness of gaskets against the percentage of the total fluid pressure for which flanges and bolts should be designed to allow for the elastic effect of the gasket. I do not maintain that the graph accurately portrays the behavior of the gaskets, since it is based on so few test data. The test data have been supplemented, however, by inspection of many gaskets from various

Fig. 6—Per cent of fluid pressure on area circumscribed by outer circumference of gasket, for which flanges and bolts must be designed to allow for gasket elasticity



types of apparatus that have been in service from a few days to many months.

The resistance to compression of gaskets is not proportional to the compressive strength of the materials. The high coefficient of friction of the asbestos composition increases its resistance to compression, in the form of gaskets, to a far greater extent than its compressive strength would indicate. I have seen asbestos-composition gaskets taken from joints that had been clamped with such force as to badly stretch the bolts, and the gaskets bore no evidence of permanent deformation except at the outer edges, which deformation was caused by deflection of the flanges.

Frictional resistance, by the way, varies with the condition of the surfaces in contact; so assigning certain frictional resistance to materials without regard for that condition is to state an approximation. The truth of this statement may be demonstrated by examining with a magnifying glass surfaces that have had various kinds of machining—"roughing cut," "finishing cut" or grinding. Obviously, the "finishing cut" surface would offer less frictional resistance than the "roughing cut," and the ground surface less than either.

As an example of the use of Fig. 6 we shall take an asbestos-composition gasket $\frac{3}{4}$ in. wide and $\frac{1}{16}$ in. thick. The ratio of the square of the width to the thickness is $0.75^2/0.0625 = 9$. The abscissa meets the asbestos-composition line on the ordinate representing 156 per cent of the fluid pressure. The flanges and bolts must therefore be designed for an additional 56 per cent of the fluid pressure. If the gasket were $1\frac{1}{4}$ in. wide there would be no "elastic effect" and the flanges and bolts would be designed for the "apparent pressure."

Special Gaskets for Special Purposes

In order to have the advantage of the elasticity of steel as a gasket material, and at the same time the malleability and corrosion resistance of copper, steel gaskets are copper-plated to a thickness of several thousandths of an inch. The spiral "threads" formed in machining the flanges imbed themselves in the copper in the manner discussed, with good results.

Corrugated gaskets adapt themselves to great imperfections of surfaces of the flanges. But because of their form they cannot sustain the high pressures of which flat gaskets are capable. Their resistance to flattening is much greater than is apparent from an inspection of a cross-section, however, as each elementary area of the section is a ring, and as such offers much resistance to the change of diameter involved in the flattening of the gasket. The grooves of the gasket are sometimes filled with asbestos and other materials which offer some resistance to flattening and also to the passage of the fluid. Corrugated gaskets, because of their form, are better adapted to large changes of temperature than solid ones of the same thickness.

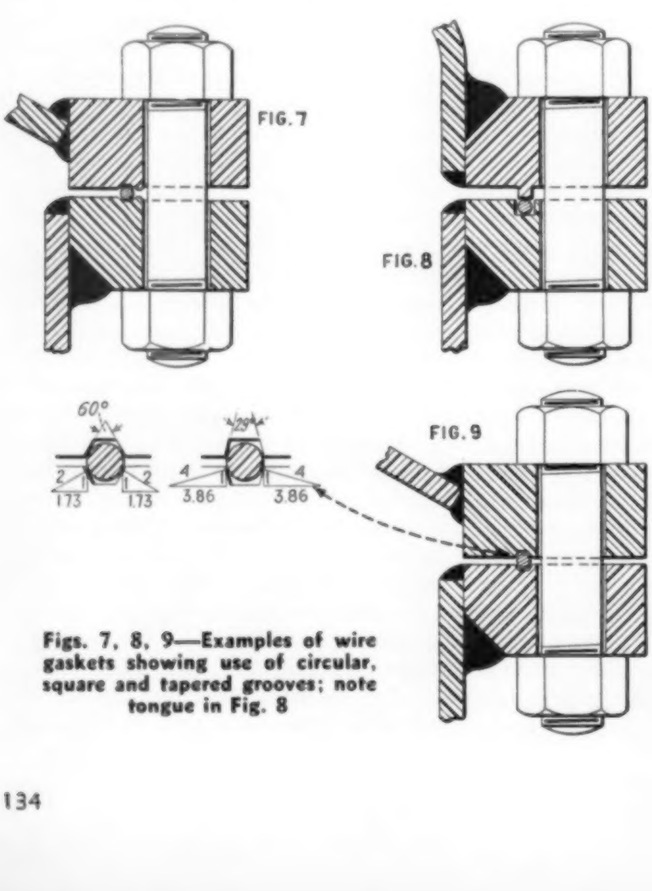
Wire or ring gaskets wedged into grooves have proved satisfactory for high pressures. One method of applying the wire is shown in Fig. 7, where the groove is an arc of a circle of 1.5 to 2 times the radius of the wire. The area of contact, far from being only a line, is dependent on the deformation of the wire and flanges. The unit pressure at the top and bottom of the wire is very high, and flattening at these points can be expected;

but the resistance of the wire as a whole is greatly in excess of that found by calculation for cylinders or rollers.

Let us assume that the bolts in the flanges of a pressure vessel impose a load of 4,000 lb. per linear in. on a $\frac{1}{4}$-in. steel wire gasket. A formula for the maximum stress in a unit length of a cylinder or roller between flat surfaces is $s = \sqrt[3]{9W^2E/8d^2}$ in which W is the load per unit of length, E the modulus of elasticity (in this case 30,000,000), and d the diameter of the wire. Solving, we find s to be equal to 205,200 lb. per sq.in. This stress is, of course, very high, but it is local and is successfully borne with the aid of the surrounding metal. If the apparent stress on the diametral area of the wire is kept within the elastic limit of the material there need be no concern about it carrying the load. For example, the load in the foregoing was 4,000 lb. and the diametral area 0.25 sq.in.; dividing the former by the latter we have 16,000 lb. per sq.in. as the apparent stress on the diameter—a reasonable stress.

I know of a closure of a piece of refinery equipment made of a copper wire, set in a square groove in the shell flange, as shown in Fig. 8. The tongue of the cover flange bore on the copper wire with such force as to form a circular groove in the steel tongue. The tongue was $\frac{1}{4}$ in. wide, which gives an idea of the resistance of a copper wire restrained by a groove. The deformation of the wire was very slight.

In Fig. 9 is shown another method of applying a wire gasket. The wedging action of the wire produces tightness with comparatively little flange pressure. In a 60-deg. groove the pressure on one face equals the total flange pressure, and in a 29-deg. groove twice the flange pressure. Thus, it is seen that by placing the wire gasket in a tapering groove, a higher sealing pressure can be obtained than with the arrangement shown in Fig. 8. Also, there is no tongue to be damaged by accidental blows. Furthermore, there is a lower bending moment in the flanges when the bolts are tightened, because the moment-arm is shorter.



Figs. 7, 8, 9—Examples of wire gaskets showing use of circular, square and tapered grooves; note tongue in Fig. 8

If elastic deformation is a desirable quality in a gasket it would have to be thick to be of any service. For example, a steel gasket $\frac{1}{32}$ in. thick, stressed to the elastic limit, would be deformed only $0.03125 \times 35{,}000/30{,}000{,}000 = 0.0000364$ in., or about one one-hundredth the thickness of newspaper. An expansion equaling the above deformation is obtained with a temperature rise of only 180 deg. F.; so where high temperatures are involved high stresses may be produced in flanges and bolts. Tongues, such as in Fig. 8, are the equivalent of narrow and thick gaskets, and consequently have a considerable elastic yield, which would impose maximum stresses in flanges and bolts.

Temperature Differences May Stretch Bolts

If gasket, flanges, and bolts are all of the same material, and are all heated to the same temperature, there will be no trouble from expansion. But because of radiation and the difficulties of conduction to the bolts, the temperature of the latter is considerably less than that of the gasket or the flanges.

In the case of a bolt threaded at the ends sufficient only to accommodate the nuts, the total elongation is divided between the two sections of the bolt inversely as the areas at the root of the thread and through the shank; and directly as their respective lengths. For example, take two flanges $1\frac{1}{2}$ in. thick and bolts 1 in. diameter with threaded portions just long enough for the nuts. The average length of the bolts may be regarded as between centers of the nuts, so we have 1 in. of threaded and 3 in. of unthreaded length. The portion of the total elongation borne by the threaded portion of the bolt is then $0.25 \times 0.7854/0.55 = 0.357$, or 35.7 per cent.

If the difference of temperature between flanges and bolts is 50 deg. F., the expansion of the flanges will exceed that of the bolts by $50 \times 3 \times 0.0000065 = 0.000975$ in. As the flanges are assumed to be rigid, the stretch of the bolts equals this expansion, and the stress in the threaded portion is $0.357 \times 0.000348 \times 30{,}000{,}000 = 10{,}440$ lb. per sq.in., which is in addition to the normal stress. If the total stress exceeds the elastic limit of the material the bolts will not return to their original length on cooling of the flanges—a condition which explains why some pressure vessels are tight while hot and leak when cold.

By threading the bolts their full length the deformation is uniform over their length and the maximum stress as found in the foregoing is reduced about 30 per cent. The use of bolts of high elastic limit will permit a greater stretch and compensate the greater expansion of the flanges. Flanges that are not too thick and rigid will also compensate, by deflection, some of the expansion and relieve the stress in the bolts. Flexible gaskets is another means of compensating differential expansion, limited of course, by their ability to carry the compression.

From the foregoing we conclude that gaskets are capable of carrying great loads without damage to themselves. In fact, it would be a narrow gasket indeed that would be damaged in an installation that is not far overbolted. A narrow gasket would, however, behave as an elastic member and should not be stressed beyond the elastic limit when subject to high temperature.

Combating Occupational Poisons

By J. D. HACKETT
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NOT ALL manufacturers have yet awakened to the fact that some of the materials they use may be dangerous to health. Conditions change so fast that they cannot always be blamed. Nevertheless, the results may be disastrous and might often have been prevented. The Workmen's Compensation Law of the State of New York specifies 27 poisons and diseases which are "compensable," with hundreds of subsidiary materials. Many of these, however, are difficult to identify as they are sold under trade names which disguise their character.

Statistics of occupational diseases in the State of New York demonstrate a remarkable fact: the number is comparatively small—perhaps 800-900 cases in all. It would be wrong to assume that this is the extent of occupational hazards in the state. There are, for instance, 200 times as many recorded cases of compensated accidents in the same period, but there is this distinguishing characteristic between them. The extent of the injury from accident is apparent and usually curable; the results from poisons, such as lead, benzol, silica, are difficult to see and, alas, often incurable.

Industrial Worker Dies Earlier

It would be wrong to deduce from the few cases of occupational disease on record that the damage caused by dusts, gases, and poisonous fumes is negligible. We have to look to other sources of information to obtain the full significance of the effect of industry upon the working man. Statistics show that the industrial worker dies several years earlier than the man with outside work. There are two remedies: one, the intelligent control of the use of poisonous substances, the other, proper ventilation. Without waiting for federal legislation to demand that all poisons shall be so labeled, it ought to be possible to get employers to take an intelligent interest in the materials which they use. They can be assisted in this by the chemical manufacturers themselves. A salesman does not always want to discuss the weak points of the chemical he sells. Yet, for the temporary advantage gained he puts himself at a permanent disadvantage when the nature of his product is discovered. A material might have been used with safety under certain conditions, but secrecy prevents the attainment of this result.

Another remedy is substitution, but it naturally is not enticing to the manufacturer whose range of products does not include the substitute. Yet, substitution is sometimes possible without loss. Recently manufacturers of foundry parting compounds ceased using a high silica product and adopted one which is practically innocuous.

Failing substitution, the adoption of hygienic measures, including proper ventilation, has to be considered. It will be news to many manufacturers that the State Department of Labor, through its Division of Industrial Hygiene, has a staff of engineers, doctors, chemists, to assist employers in the solution of problems relating to hygiene. The law, indeed, demands that every factory shall be provided with means of eliminating dangerous dusts, fumes, and gases, and it is only to be expected that the state should facilitate means of complying with the law. Every employer may secure expert advice simply by asking.

Hygiene is coming to be considered as an integral part of plant design and operation. After twenty years of aggressive work the trail has been blazed for "Integral Hygiene." Structures are now being designed with reference to ventilation requirements and manufacturers are equipping machines with integral hoods. Laundry machinery, for instance, is now in most cases, made completely covered for control of heat and steam. Nevertheless, there is much to be done. Some gas appliance manufacturers are selling equipment without the necessary means for preventing carbon monoxide poisoning and lead pots are still being manufactured without hoods, although the law demands that every lead pot shall be hooded. A few years ago, almost overnight, the world took to chromium plating. Outfits were erected all over the country without proper exhaust apparatus and much occupational disease resulted. Nevertheless consistent progress is being made and we can look forward to the time when no factory will be erected, no machinery installed, and no worker employed, until the requirements of hygiene have been fully satisfied.

Another aspect may be alluded to briefly. No matter what the employer does he will continue to have cases of occupational disease unless he gets the cooperation of the worker. The state realizes this and much effort has been made to solve this problem. A typical instance of this was the inauguration of the Governor's Labor Union Safety Committee by President Roosevelt while he was governor of the State of New York. The purpose of this committee is to get workers to take an active interest in the prevention of accident and occupational disease. Employers complain that they provide masks, goggles, and other apparatus for the workers which they will not use. But if the employer is really interested in maintaining healthy conditions, the response will be generous. No employer can hope for success if he thinks that it is all the worker's fault if the factory is not kept in good shape. The truth of the matter is hygiene can only be effected by the combined efforts of worker and employer.

Galvanic Corrosion

CORROSION tests by the International Nickel Co. recently made in concentrated brine solution have brought out a feature of galvanic action that is of particular interest, and not usually recognized.

This is that the accelerated corrosion of the anodic metal in the couple may be considerably greater with one cathode material than with another in the same range of apparent nobility with respect to iron. For example, in the case of cast iron coupled with Monel metal and with 18-8 stainless steel respectively, Monel metal led to 20-40 per cent less galvanic attack than the stainless. The anode and cathode areas and conditions of test were identical.

PETROLEUM Industry

Maker and User of

By ARTHUR L. DAVIS

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INTEREST in the petroleum industry is steadily increasing as far as chemical industry is concerned. The two-way traffic in products and processes has recently grown to surprising proportions. The oil refinery is not only a source of many chemical raw materials, but is itself an important market for chemical products. Its requirements, once satisfied with inorganic acids, alkalis, sulphur and a few salts, now extend to a wide range of intermediate and finished products of organic origin. Furthermore, the petroleum industry is now the leading market for our chemical engineering graduates. Its most important advances have been in the direction of improvements in the use of the unit operations of chemical engineering.

Interest in petroleum as a chemical raw material has occasionally led to fanciful and distorted pictures of the possibilities offered in this field. Enthusiasts have often drawn the comparison with the brilliant chemical accomplishments based on coal tar, but to date only a very few of petroleum's possibilities have been realized. It is the purpose of this article to point out some of the progress that has been made in this direction and then to show, from the opposite side of the ledger, how the development of two of the many new refinery processes has opened the market for a wide variety of chemicals.

Before dealing thus specifically with these inter-relations, it is of interest to compare the production and value of products of the petroleum industry for 1931 and the value of products of the chemical and related industries for the same period. Most recently available data of the U. S. Census of Manufactures have been summarized in Table I.

The extreme diversity of products in the chemical industry and the manner of reporting them has not made it possible to include its production converted to a common unit such as gallons or pounds. It is significant to note that with twenty-two times as many plants engaged in the chemical industries, the combined value of all products is less than twice the corresponding figure for the petroleum industry. The average annual production of 763,000,000 lb. of petroleum products per plant may be compared with that of any particular branch of chemical industry to show the striking difference in the weight of materials produced. In general, chemical industry produces low-volume, high-value materials, while the petroleum industry produces high-volume, low-value materials.

The quantities and value of the products of the petroleum industry for 1931, summarized from information published by the U. S. Bureau of the Census are given in Table II in order that reference may be made to the relative position of the most important classes of products from the standpoint of products and unit values.

As Source of Raw Materials

Interest in petroleum products which may serve as raw materials for chemical manufacture has, for the most part, been narrowed to the paraffin and olefin hydrocarbons containing up to six carbon atoms and to the paraffin hydrocarbons with 20 to 40 carbon atoms. Ethylene, at the present time, is probably the most important from a chemical standpoint. It is not only the basis of synthetic ethyl alcohol, but is also the source of synthetic acetic acid, of ethylene glycol and the many related synthetic organic chemicals. Propane and propylene, pentane and butane are all being used as chemical raw materials.

The lower boiling paraffin hydrocarbons have been dehydrogenated, halogenated, and oxidized with subsequent polymerization, hydrolysis, and esterification, as

Table I. Relative Production and Value of Products of Chemical and Related Industries and Petroleum Industry for 1931

	Chemical and Related Industries	Petroleum Industry	Ratio Chemical to Petroleum
Establishments	7,963	358	22.2 :1
Production:			
Million gallons		37,420	
Million pounds		273,166	
Mil. lb./establishment		763	
Value:			
Million dollars	2,513	1,511	1.7 :1
Cents per gallon		4.0	
Cents per pound		0.5	

Table II. Production and Value of Petroleum Products for 1931

	Production Million Gallons	Value Million Dollars	Value Cents per Gallon
Gasolines	16,958	825	4.9
Fuel oils and gas oils	15,193	294	1.9
Lubricating oils	1,141	196	17.2
Kerosenes	1,730	72	4.2
Naphthas	492	22	4.5
Asphalts	525 equiv.	22	4.2
Paraffin waxes	79	13	16.4
Lubricating greases	45	12	26.7
Road oils	378	10	2.6
Coke	500 equiv.	7	1.4
Liquefied gases	255	6	2.4
Miscellaneous	310 est.	31	10.0 est.

CHEMICALS

Chemical production from petroleum raw material calls for large-scale chemical engineering processes and equipment

desired. The olefin hydrocarbons have been halogenated, hydrated, oxidized and polymerized with subsequent hydrolysis, esterification and separation as required. The paraffin waxes have been dehydrogenated, halogenated, and oxidized, followed by polymerization, condensation, or esterification, respectively, to produce materials such as synthetic lubricants, pour-point depressors, and fatty oils.

The lower boiling paraffin hydrocarbons are separated into individual compounds of commercial purity by fractionation, while most of the corresponding olefin hydrocarbons require chemical or physical means, or both, for adequate separation. The enormous increase in the number of possible isomers with increasing size of the molecule makes it appear that only the lower members of these two series will be available in quantity for direct chemical utilization.

The paraffin waxes will probably continue to hold promise for further commercial utilization where pure compounds are not required. The specter of possible isomers may not be easily disposed of since there are 366,319 for eicosane, $C_{20}H_{42}$, and this may be considered as the low limit.

Gas oils from catalytic or thermal processes seem to offer a fertile field for study. Many of these gas oils with distillation ranges between 250 and 450 deg. C. are highly aromatic as shown by their solubility in sulphur dioxide. Their complexity, of course, indicates problems analogous to those encountered with neutral oils from coal tar, but low-cost raw material of this nature should yield positive rewards.

Much has been written recently about the possibilities of removing and recovering sulphur from petroleum. The crude petroleum from fields in the United States will contain, on the average, more than 0.25 per cent total sulphur. This represents a daily production of at least 1,687,500 lb. of free and combined sulphur in 2,250,000 bbl. of crude and is co-incidentally about the minimum quantity of total sulphur entering the average petroleum refinery in one year. The removal of sulphur compounds has received considerable attention, especially where the total sulphur content exceeds 0.5 per cent. The inorganic and organic catalogs have not yet yielded reagents capable of producing the desired reduction chemically or physically at low cost, and without excessive losses.

Conversion of higher boiling hydrocarbons into lower boiling products has progressed through the stages of yielding an adequate volume of motor fuel and imparting to that fuel better high-pressure combustion characteristics. The thermal conversion of hydrocarbons, under an infinite variety of combinations of charging stock, pressure, and temperature, maintains a leading position in petroleum processing. Catalytic conversion has been investigated contemporaneously with somewhat better success in recent years. The catalytic processes may proceed more rapidly when the conversion activity of solid catalysts is increased and the time required for revivification is reduced.

As Consumer of Chemical Products

Now let us look at a few of the refining processes that already point the trend toward a greater utilization of chemical products. The refining of lubricant distillate and residuum stocks is generally completed by combinations of treatment with concentrated or fuming sulphuric acid, alkali and adsorbent earth, where effective separation of the respective fractions has not been re-

alized. The preferred viscosity-temperature characteristics of Pennsylvania-grade crude lubricants, which are even exceeded by the better synthetic lubricants, has urged the development of solvent extraction methods for the separation of the naphthene hydrocarbons from the more desirable liquid paraffin hydrocarbons. Proposals have been made to separate liquid hydrocarbon mixtures by the use of such selective solvents as aniline, propionaldehyde, benzaldehyde, acrolein, crotonaldehyde, furfural, phenyl acetate, tricresyl phosphate, dichloroethylether, ethylene glycol ether, methanol, ethanol, propanol, pentanol, furfuryl alcohol, phenol, phenol-water, phenol-methanol, phenol-glycol, sodium phenolate-glycerol, cresylic acid-propane, wood tar acid-propane, acetone, acetone-water, benzonitrile, nitrobenzene, dinitrotoluene, sulphur dioxide, sulphur dioxide-benzene, and methyl thiocyanate. Sulphur dioxide is the veteran of the group with evidence of current interest centered in aerolein, crotonaldehyde, furfural, dichloroethylether, phenol, cresylic acid-propane, nitrobenzene, and sulphur dioxide benzene.

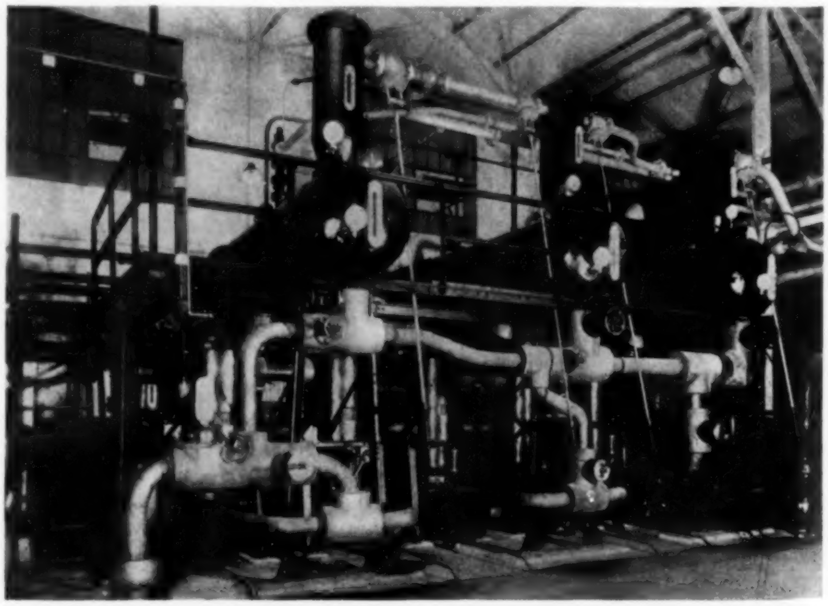
The dewaxing of lubricant distillate and residuum stocks is required for most wax-containing oils. The stocks are generally dissolved in a low-boiling petroleum naphtha, chilled, and settled or centrifuged with the subsequent removal of the naphtha. The effectiveness of the separation depends on the relative solubilities of the oil and the wax in the ternary system and on the completeness of separation of the solid from the liquid portion of the chilled mixture. Suggestions have been made to separate the liquid from the solid hydrocarbons by the use of such selective solvents as acetic acid-benzene, paraldehyde, ethyl formate, butyl formate, ethyl acetate, dimethyl ether, methyl chloride, methylene chloride, ethyl chloride, dichlorethane, ethylene dichloride, ethylene dichloride-benzene, trichloroethylene, propane, petroleum, naphtha, ethanol, ethanol-xylene, butanol, butanol-acetone, butanol-benzene-naphtha, isopropanol-naphtha, butanol-naphtha, pentanol, acetone, acetone-benzene, acetone-butanol-naphtha, methylethylketone, butanone and sulphur dioxide. Petroleum naphtha is the most extensively used member of this group, with most current interest evidenced in propane and acetone-benzene. Use of inorganic or organic compounds for influencing crystal formation may materially affect the selection of the proper solvent for dewaxing.

Increased chemical interest in refined products has resulted from the commercial introduction of tetraethyl lead to gasoline ten years ago by addition in the service station of 3 c.c. per gallon of the commercial fluid. Its successful use in premium price motor fuels, however, resulted in sales that did not exceed ten per cent of the total consumption. The widespread addition of tetraethyl lead to regular priced motor fuels during the summer of 1933 has materially increased its distribution even though the quantity used has not gone up in direct ratio. Motor fuels have been made, and have gained some use in which are incorporated small proportions of amines, esters, ethers, aromatic or unsaturated hydrocarbons, hydroxy compounds, ketones, nitro compounds, and nitrogen bases, with commercial benzol finding the best demand. Those anti-detonants of which only very small proportions are required, and which have been claimed to be effective for this purpose, are represented by such compounds as triethyl arsine, triphenyl bismuthine, dimethyl cadmium, cyanoform, ethyl iodide, tetraethyl lead, tetraphenyl lead, iron acetyl acetonate, iron carbonyl, iron ethyl amino pentacarbonyl, iron tetracarbonyl, mercury cyanide, mercury naphthenate, nickel carbonyl, tetraethyl phosphine, dianilino diselenide, diethyl selenide, diphenyl selenide, seleno cyanate, triphenyl stibine, diphenyl sulphide, titanium tetrachloride, diphenyl telluride, organic thallium salts, tetraethyl tin, amino-p-cymene, aniline oleate, anisidin, diamino mesitylene, and butyl ester of hydroxy naphthenic acid.

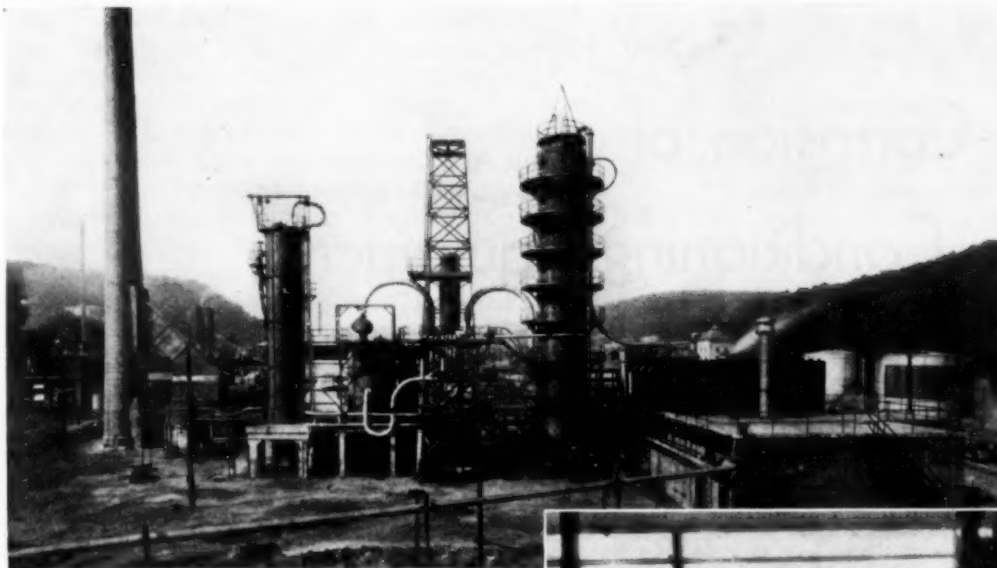
New products made daily in the many chemical research laboratories afford an ever increasing threat to such an apparently impregnable monopoly now said to be supplying the best anti-knock formula from over 30,000 compounds examined. It may not be desirable to discard from consideration a compound which promotes detonation since such materials seem to improve the quality of diesel motor fuel.

Gum Inhibitors, Anti-oxidants, Pour-point Depressors

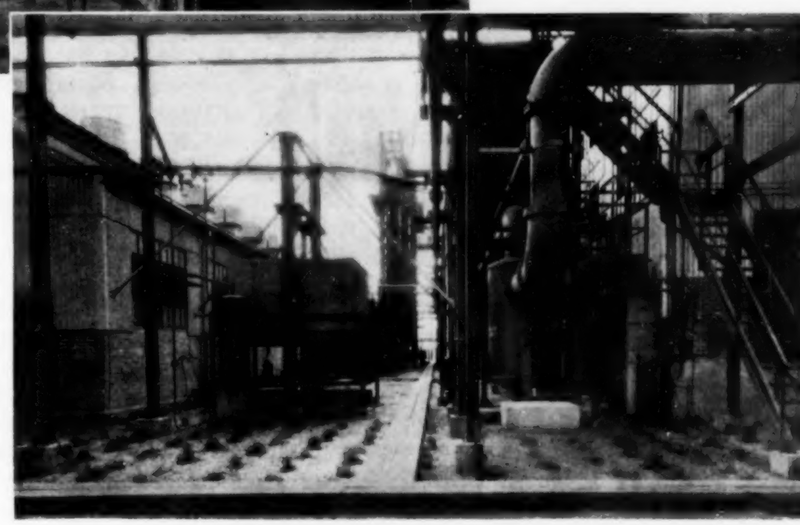
A decrease in color and gum stability of motor fuels confronts the refiner who attempts to operate a catalytic or thermal conversion process at higher temperatures or who attempts to lower costs by a material reduction or elimination of distillate refining. Fresh distillates may have good color and contain no gum but a marked change in these characteristics may be only a matter of days or weeks. Compounds which have been presented for the purpose of stabilizing color or gum include butylamine,



Tide Water produces improved turbine oils by Edeleanu process in which liquid SO_2 replaces sulphuric acid



Latest type of Dubbs process cracking unit installed in a newly modernized Pennsylvania refinery



In the petroleum hydrogenation plant at Baton Rouge, La., where a wide variety of chemicals may be made

acetanilid, ammonia, ethylene diamine, dimethylamine, diphenylamine, alpha naphthylamine, phenyl alpha naphthylamine, aldol alpha naphthylamine, ethanolamine, p-methyl amino phenol, p-benzyl amino phenol, anthracene, naphthalene, phenanthrene, phenol, cresol, creosol, hardwood tar, catechol, hydroquinone, orcinol, resorcinol, pyrogallol, alpha naphthol, beta naphthol, alpha naphthylene-azo-alpha napthol, cephalin, lecithin, semicarbazide, diethyl phthalide, phthalimidine, brucine, methyl pyridin, nicotine, anthraquinone, quinone anilin-imine, ethyl seleno mercaptan, thiocarbanilid, thiourea, and camphor.

Lubricating oils are considered as consisting of one or more mineral oil lubricant stocks with or without the addition of organic acids or animal or vegetable fats or oils. The oxidation of highly refined mineral oils, such as transformer oils, turbine oils, and white oils, is first evidenced by the formation of acidity followed by sludge accumulation, while the oxidation of moderately refined lubricating oils, such as airplane oils, automobile oils, diesel oils, and tractor motor oils is usually evidenced only by sludge formation. Several oxidation inhibitors, mainly used in highly refined mineral oils or compounded oils include oxalic acid, tartaric acid, peracetic acid, oxamid, tributylamine, diphenylamine, ethylene diphenyl diamine, phenyl alpha naphthylamine; reaction products of aldo-alpha naphthylamine, acetaldehyde-aniline, aldo-ethylene diphenyl diamine, phenyl phenol-diphenyl guanidine; p-amino phenol, diacetoneamine, triethanolamine, p-hydroxy diphenyl ether, p-ethoxy diphenyl ether, hydroquinone, pyrogallol, hydroxy diphenyl, alpha naphthol, beta naphthol, methylene dibeta naphthol, dicyanimide, piperazine, glyoxaline, nitrogen bases from petroleum, toluonitride, and tetraethyl lead.

The pour point of a motor oil has some bearing on its utility at low temperatures. It is definitely influenced by the waxy hydrocarbons present, which become increasingly difficult to remove as they decrease in quantity. The search for materials which would obviate the final stages of wax separation has resulted in the identification of a number of compounds among which are hydroxystearic acid, fractions from coal tar, chlorinated paraffin wax-naphthalene condensates, petroleum wax tailings, aluminum ricinoleate, aluminum stearate-glycerol, lead oleate, magnesium hydroxystearate, magnesium soap of oxidized paraffin wax, sodium naphthenate, zinc degras soap, zinc hydroxystearate, and zinc soap of oxidized paraffin wax. The chlorinated paraffin wax naphthalene condensation product is the principal commercial product of the group.

Many intermediate and finished products, particularly of the organic chemical industry, have found a place in the petroleum industry after having been developed for other purposes. It is of primary importance from the merchandising viewpoint for the chemical manufacturer to have adequate preliminary knowledge of potential uses in order that diversified distribution may proceed with the maximum patent protection.

How to Avoid Corrosion of Air-Conditioning Equipment

By WAYNE H. CARTER
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AIR CONDITIONING is defined by the A.S.H.V.E. Guide as the simultaneous control of all or at least three of the factors affecting both the physical and chemical conditions of the atmosphere within any structure. These factors include temperature, humidity, motion, distribution, dust, bacteria, odors, toxic gases, and ionization.

In systems of the type alluded to as central station type, the air is washed with a series of sprays which remove the impurities to a greater or lesser extent, depending on the contact between the air and the spray and the action of these impurities on the pH value of the water.

In general, the temperature and humidity are regulated by controlling the dew point or the temperature corresponding to saturation for a given moisture content. This is attained by bringing the air into intimate contact with sprays of water maintained at a given temperature, dependent upon the conditions to be maintained within the enclosure. The effect of these sprays on the circulated air is comparable to that of rain on the atmosphere. Recent tests have shown that, in industrial centers, the quantity of sulphur dioxide and carbon dioxide normally present in the air is reduced to about ten per cent during and after a rainstorm. The same effect is obtained in air-conditioning equipment, but the degree of removal is entirely dependent on the purity of the circulated water, unless the water is capable of reacting with the impurities and removing them from the air. The questions of air motion and air distribution are of no consequence in the field of corrosion except in isolated cases of industrial air conditioning.

It is a recognized fact that the corrosion of air-conditioning equipment depends on the following factors:

1. Fresh water composition.
2. Absorption of impurities by the circulating water and the resultant catalytic effect of iron sulphate and copper sulphate on oxidation of sulphur dioxide to trioxide. The main impurities are carbon dioxide, sulphur dioxide, and sulphur trioxide, all of which are acidic in nature and cause low pH values in the water.
3. Practically complete saturation of the water with air.
4. Impingement of the high velocity spray on the metal surface.
5. Dissimilar metals in contact.

It should be pointed out at the start that merely because a building is equipped for air conditioning difficulties from corrosion may not necessarily arise. I have inspected equipment which has operated satisfactorily for years without any major expense for repairs or any signs of serious deterioration. In the same community, I have also seen air-conditioning systems fail in three months generally on account of local conditions traceable to air pollution by products of combustion. Certainly this is not the fault of the equipment manufacturer. In nearly every case, strictest attention is paid by architects, engineers, and manufacturers to the proper location of the outside air louvers to obtain an air supply from the most favorable location. In the main, corrosion in air-conditioning equipment may be attributed to the presence of a smoke problem, to products of combustion.

Examine the Water Supply

I have always considered it a serious mistake by manufacturers of air-conditioning equipment not to point out to their customers the wisdom of having the water analyzed periodically, and of conditioning the water whenever it is found necessary. This industry may profit by following the leadership of boiler manufacturers, in pointing out the possibility of trouble from this source, and the steps required to overcome it.

Chemical analyses of the fresh water supply are usually available to the owners of air-conditioning equipment. If not, the leading air-conditioning manufacturers have experienced chemists or chemical engineers on their staffs who can readily obtain such information. Or the problem may be referred to specialists in the field of water analysis.

Unfortunately, however, an examination of the fresh water supply is, by itself, no criterion whether or not corrosion may be expected in air-conditioning equipment, unless the water itself is very corrosive, which is generally not the case. All manufacturers of air-conditioning equipment point out to their prospective customers the fact that air conditioning provides a cleaner, purer, more sanitary air supply. A logical question to ask is, "What happens to the impurities?" Also, "What impurities are present, and to what extent are they removed?"

The answer to the first question is self-evident. There is only one place where the impurities can go, the water

which is being used to wash the circulated air. In general, the main impurities which are being removed by the equipment are acidic in character, and are mainly carbon dioxide, sulphur dioxide, and, to a lesser extent, sulphur trioxide. These are usually the most important impurities from a corrosion viewpoint, although there are instances where hydrogen sulphide is the main factor.

Obviously then, in addition to an analysis of the fresh water supply, there must be also periodical examinations of the water circulated in the system. These examinations should cover daily samples up to and including the time when the water is discharged, which in most cases is recommended after one week's use. Chemical analyses of these samples should include pH, silica, iron and alumina, lime, magnesia, and zinc in some cases, if not in all. The latter determination should be included in all cases where the equipment is galvanized. In case copper equipment is used, the analysis should include this metal. The anions determined should include chlorides, sulphates, carbonates, bicarbonates; in other words, the examination should be complete. No explanation of the derivation of the pH value needs to be included in this connection. All that is necessary is to understand that in water a pH value of 7.0 indicates neutrality; that above 7.0 the pH value indicates alkalinity, the degree of alkalinity increasing as the numbers increase; and that below 7.0 the pH value indicates acidity, the acidity increasing as the numbers decrease.

Galvanized Iron vs. Copper

Practically all central station equipment is made of galvanized iron, copper, or sheet iron. It has been my experience that galvanized iron is satisfactory in most cases encountered in air conditioning, and that plain sheet iron or steel is not acceptable for general use. Copper equipment, although required in some cases, is generally not necessary. Experience has shown that with proper water treatment, galvanized iron is entirely satisfactory.

The central station air-conditioning system operates as a dehumidifier or humidifier according to outside weather conditions. In all cases the outside air passes through the sprays, where it is washed by the water which removes the impurities to a greater or lesser extent, depending on the intimacy of contact between the air and water and also on the quantity of gaseous impurities contained in the water. This latter fact, apparently not recognized by some air-conditioning manufacturers, is directly related to pH values. It is possible to conceive that the water in the air-conditioning system acts as a reservoir for gases such as carbon dioxide (or sulphur dioxide), building up the concentration of the gas when its partial pressure in the air is high, and releasing part of it when the partial pressure is low. Proper treatment of the water actually increases the purity of the air coming from the dehumidifier, in addition to minimizing corrosion. This has been confirmed by recent tests involving the removal of carbon dioxide and sulphur dioxide from air, in which proper water treatment has reduced the sulphur dioxide from 0.2 to 0.25 p.p.m. to a maximum of 0.02 p.p.m. In most of these tests negative results for sulphur dioxide were obtained when the pH value of the water was held at 8.7 by the continuous addition of Vaporene A.

It has been found by laboratory tests followed by actual observations in the field, that the pH value of water in galvanized iron equipment should be about 8.5 to 9.0. This alkalinity should be maintained by continuous addition of proper chemicals which cause a protective coating to build up on the metal.

It should be emphasized that the pH value is only one indication. It does not follow that no corrosion will take place if the circulating water be maintained at a pH value of 8.5. If the chemical added to the water is not film building in character the corrosion may be increased. Use of sodium hydroxide alone in air-conditioning equipment is not permissible. The treatment must involve some material which will form a protective coating on the metal surface, or which will passivate the metal. Proper conditioning of the water will include the use of materials such as sodium hydroxide, sodium silicate, sodium phosphate, or sodium dichromate, in various combinations. Recent tests have shown that, disregarding minute quantities, these chemicals are not carried by the air into the occupied spaces, and when they are, this is a sign that the eliminator surface is insufficient. If conditions are right, the ordinary methods of analysis are not sufficiently sensitive to permit the determination of the quantities present in samples of 5 to 10 cu.ft.

It is a well recognized fact that part of the acidity developed by circulated water in an air-conditioning system is due to dissolved carbon dioxide. A fact which is not sufficiently well understood, however, is that both copper sulphate and ferric sulphate, and to some extent also zinc sulphate, catalyze the oxidation of sulphur dioxide to trioxide, which in turn reacts with the water to form sulphuric acid. This explains the increase in the sulphate or the sulphuric acid content of the circulated water. Under proper conditions of water treatment, the catalytic effect of ferric sulphate is avoided, formation of sulphuric acid is prevented, and the sulphur dioxide, with carbon dioxide, reacts with the chemicals and is removed from the air. It should be recognized that during summer operation the water in the dehumidifier passes through a refrigeration machine where the problem of heat transfer is of paramount importance and where scale must not be allowed to accumulate. Recent tests indicate that the proper use of chemicals in the water, although actually building up a protective coating on the metal surface, does not result in a decrease in the rate of heat transfer. Scale of corrosion products, however, affect the rate of heat transfer markedly and may result in actual failure of the equipment or in costly repair or cleaning bills.

Adding Years to Life of Equipment

It is readily apparent then, that proper treatment of the water adds years to the life of the equipment and makes the operation more satisfactory from every viewpoint. In an industrial atmosphere I have seen the water in a dehumidifier absorb sufficient impurities to reduce the pH value from 6.8 to 3.8 in one day's operation. Naturally, the life of this equipment was short. Proper water conditioning also protects the piping system and cooling towers, which, in some cases at least, are as valuable as the air-conditioning equipment proper.

It has been demonstrated in the field that the use of

proper chemicals in the spray water not only reduces the corrosion but also the quantity of sulphur dioxide and carbon dioxide to a point where careful chemical manipulation is required in their determination. Where this removal is affected the pH value is within the range offering maximum protection, 8.5-9.0. For galvanized iron, the maximum pH value for safe operation has been found to be 9.0.

It is a well recognized fact that corrosion in water is reduced to a minimum by excluding oxygen. It is apparent, however, that this is not possible in air-conditioning equipment. Recent tests show conclusively that the use of certain chemicals such as sodium dichromate, or better, sodium chromate, curtails the corrosion caused by dissolved oxygen. This corrosion is also minimized by following the manufacturer's instructions and protecting the metal with suitable coatings. In this connection it has been found that rubber-asphalt base paints, properly applied, offer good resistance to ordinary corrosion in this type equipment.

Inspection of the protective coating on the dehumidifier, eliminator plates, and baffle plates should be made at least twice a year or oftener, and the metal surface should be kept covered. Or perhaps it would be better, assuming that water examinations are being made, that the inspection of the equipment depend upon the findings from the water examinations.

Both of these elements of corrosion are problems in design. However, they are both linked directly to the question of proper water conditioning and to the use of protective coatings.

Impingement effect is apparent in some small central station machines and in under-designed units equipped with sprays operating at high pressures. Corrosion of this nature is accelerated by low pH values. I have seen instances of serious impingement effect in three months' time due to acid water.

Dissimilar Metals Cause Trouble

The question of dissimilar metals in contact is one of serious import. Generally, it is overcome by insulating or isolating the different metals. Use of rubber, asbestos, and, more recently, pressed paper and wood has helped to overcome this difficulty. Most air-conditioning engineers keep the number of different metals in their equipment at the minimum figure. Use of plastics in several test installations is being watched with much interest.

No difficulty is generally encountered from corrosion in the air ducts except in isolated cases of industrial equipment. Galvanized iron is used in nearly all cases for duct construction and has been found to be in satisfactory condition after years of service. Certain types of industrial air conditioning require the use of stainless steel or aluminum for duct work, as in the rayon industry. This additional expense, however, can rarely be justified, except in special cases where even small quantities of impurities cannot be tolerated.

Most air-conditioning equipment utilizes finned tubing construction for heating and tempering coils. These heaters, which are placed in the outside air supply as well as in the circulated air, are steam-heated; they are generally made of copper.

I have never seen an instance of serious corrosion on the air side of this heating equipment in comfort cooling and but one example in industrial air-conditioning equipment, this being due to a high content of hydrogen sulphide and a resultant catalytic action. This was corrected by the use of a special metal (aluminum in this case).

Corrosion on Steam Side

Corrosion on the steam side is directly dependent on the quality of the steam. With a low pH value in the condensate there is an attack on the natural basic protective coating, exposing fresh metal, and resulting in the action being localized at the surface of the liquid where the oxide coating and metal meet. This type of corrosion may be recognized by the deep ridge at the surface and the wearing away of the natural protective coating below that point.

Some engineers are convinced that, for this type of service, it is better to have some oxygen present in the steam, contrary to practice with iron equipment. This is open to serious argument. I have seen cases of corrosion of copper heating equipment linked directly to the presence of oxygen in the condensate, the latter being acidic in nature. This type of attack is generally greater at the entrance end of the heater.

Another factor which contributes greatly to corrosion in this type of heating equipment is iron oxide scale carried over from the boiler and deposited on the copper tube. A potential difference between the metal (or its natural coating) and the iron oxide, in the presence of the condensate, results in a pitting which may be recognized by combined chemical and microscopical examination.

It should be emphasized, in conclusion, that owners of air-conditioning equipment should protect their investments by periodically checking up on the water being sprayed in their equipment. This should be done by engineers and chemists specializing in this type of corrosion study; if an examination of the water shows that corrosion is taking place, proper steps should immediately be taken to adopt the proper form of water conditioning, to maintain the pH value of the water at 8.5-9.0 by continuously adding the proper chemicals; to overcome the catalytic effect of ferrous sulphate (copper sulphate); to form a protective coating on the metal surfaces; and to insure a cleaner air supply by absorbing and neutralizing gases such as sulphur dioxide and carbon dioxide.

In regard to heating equipment, it is recommended that a firm of competent engineers, specializing in this type of work, check up on the nature of the condensate and insure the use of the proper quality of steam.

T.A.P.P.I. Discusses Codes At Meeting

THE Technical Association of the Pulp and Paper Industry held its annual convention in New York the week of February 19. On every hand the chief topic of conversation either directly or indirectly concerned the effects of the codes on the pulp and paper industry. President Allen Abrams devoted much of his annual address to the influence of the codes. He said in part, "Today we have manufacturers getting together for intelligent discussion and solution of their problems. The business man who formerly prided himself on being hardheaded has generally found that he was either boneheaded or selfish. If the new deal calls for anything it demands fair play, more equitable distribution of material wealth, a greater opportunity for leisure and some real exercise of the Golden Rule." Deputy Administrator W. W. Pickard of the Paper Division of National Recovery Administration, the guest speaker at the annual luncheon, spoke on the nature and purpose of the N.R.A.

In the industry the various groups are engaged in working out details of their cooperation under the codes. One of the most difficult problems has been to define grades and to specify the qualities for each grade. Frederic C. Clark, vice president of Skinner & Sherman, reported on trade names and their significance. His report is a continuation of the work of the Committee on Paper Classification in that each paper has been studied and given a numerical classification number. In this study it has been found necessary to make a few minor changes in the subdivisions set up by the Paper Classification Committee, but throughout this work there has been a strict adherence to the principle they set up, namely that a classification plan must be based upon "methods of manufacture" and not upon uses or qualities.

De-Inking Paper

In the classification set forth, all papers have been divided into ten major groups called Types; each Type is divided into ten subdivisions, where necessary, called Classes and each Class may be further subdivided into ten subdivisions called Kind. With the chart Clark submitted it is possible by the use of three numerals to designate every paper now produced as to type, class and kind, no attempt being made to include quality, color, finish and the like. In this plan the first numeral (in hundreds place) indicates the Type, the second numeral (in tens place) shows the subdivision under Class and the third (in units place) shows the subdivision under Kind.

A new process wherein groundwood papers printed with an ink having the iron lake of haematein as a pigment are reused, was discussed by Sidney D. Wells, technical advisor. Combined Locks Paper Co. (See *Chem. & Met.*, Vol 40, p. 634, 1933). The ink is removed by the reducing and acid action of sulphur dioxide on the nodulized wet stock. Rod mills are used to prepare the stock for the sulphur dioxide treatment and subsequent washing.

Thermal insulation with aluminum foil was the subject of a paper by J. F. O. Stratton of Ross Industries Corp. The use of Alfol is a complete departure from the physical characteristics of all other insulating materials. Aluminum is an extremely efficient conductor of heat, especially in the wrought sheet form, having a conductivity of 1,430 B. t. u. per in. thickness per deg. difference per sq. ft. per hr., according to Stratton. This is diametrically opposed to a great many other insulating materials, which have the characteristic of low density, and indicate their efficiency, as insulation, almost in direct parallel to their specific weight and density.

Efficient insulation is obtained with Alfol, not only by high reflectivity of its surfaces, but also by the additional insulating effect obtained in the air space between the various layers. Thus by laying three layers of aluminum foil in a one inch space, having two $\frac{3}{8}$-in. air spaces, between the layer, and two $\frac{1}{8}$-in. air spaces between the hot surface and the cover of the insulation, an insulating efficiency has been obtained in excess of that of the best insulating material heretofore employed.

Belt Drives

Flat belt drives were discussed by Frank W. Parkhurst, a mechanical engineer of Indianapolis. He stated that flat belt drives have inherent characteristics that make this type of drive quite suitable for most applications. Speaking of the selection of the proper size belt to use, Parkhurst said, "Much previously published information on correct size selection of flat belts has taken too little account of what you will consider as satisfactory length of life and the actual load that the belt may be called upon to carry under all conditions. Even when sincere effort has been made to follow the generally accepted practice as to suitable size selection too many flat belt drives have fallen short of all that could be desired. And we all know how many, many times the belt size has been chosen only by a mighty rough 'rule of thumb' or even 'by guess' or to suit a pulley size that somebody 'guessed' would do.

"The general tendency in determining belt size has been to apply belt manufacturers' recommendations as to belt capacity against nominal or average loads instead of against the peak loads to which the drive will be subjected."

Two papers dealing with the use of new pigments were presented. One of these was on beater addition of titanium pigments and was given by William R. Willets, a chemist for the Titanium Pigments Co. The general theory of the opacity and brightness of paper was discussed with special reference to the titanium pigments. The opacity and brightness developed by the use of titanium pigments in comparison with the common paper fillers was shown for unwaxed and waxed papers. The opacity of these pigments in a waxed or oiled paper demonstrates their efficiency in preventing "show through".

V. A. Belcher of the New Jersey Zinc Co. presented a discussion of the use of zinc sulphide pigment to increase the opacity of a sheet to permit the use of lighter sheets for mailing. He gave a number of calculations demonstrating this fact. New uses for this pigment were cited. These include waxing paper for food wraps, boxboard, absorbent paper, fruit wraps, paper pie plates.

BOOKSHELF

Alkali Exposition

Manufacture of Soda. By *Te-Pang Hou, Ph. D.* Published by the Chemical Catalog Co., Inc., New York. 365 pages. Price, $8.

Reviewed by *Harald Ahlqvist*

DR. HOU has written a timely book which will become of historical interest, as it clearly and fully exposes the present practice in the manufacture of ammonia soda.

The first three chapters are devoted to the development of the soda industry and to statistics of its present status. Some of these are undoubtedly based on preliminary figures for on page 34 the total production of soda ash in the United States is given as 2,024,000 tons for 1931. It actually was 2,275,416 tons, and the operation was 76 per cent of rated capacity instead of 68 per cent, as stated. Actually, the rate was even higher than 76 per cent of January 1932 capacity because the additional equipment was not all available during the whole of 1931. On page 30 Dawsonite is given as $Na_2Al(CO_3).2Al(OH)_3$ while the U. S. G. S. in Bulletin 95 gives the formula $Na_2Al(CO_3)_3.2Al(OH)_3$ a sodium-aluminum carbonate and aluminum hydroxide and not a chloride indicated in the text.

Beginning with chapter IV the theory and modern practice of operating soda plants are considered in detail. Many tables of analyses of the progressive steps in the apparatus demonstrate the reaction, and complete calculations, as commonly used in the industry, give the heat balances in each individual apparatus. The detailed operation of the apparatus is evidently based on personal experience and particular mention is made of all conceivable operating troubles, both probable and improbable. These descriptions should be of great value to the operator, as in most cases the reasons are given for the disturbances and advice on how to prevent them, or to overcome them. Dr. Hou still doubts the value of brine purification before ammonia absorption; modern practice is, however, generally adopting it. The chapter on lime burning is particularly good, and deserves careful attention, proper lime burning being one of the most important factors in successful soda manufacture.

Table 41, on page 89 representing composition of ammoniated brine is inaccurate in certain respects. The total ammonia is lower than in common practice; on page 89 is mentioned 97 to 95 for NH_3 as the optimum titre, while actually 98 to 99 is used in practice. On page 82 the settling of the ammoniacal brine is described as taking place after completed ammoniation. It would be better to settle after the upper part of the absorber, before the first cooling. The dimensions given of Solvay carbonating towers can only refer to a specific case.

In general the description of the equipment depicts an installation evidently erected years ago, and does not include various developments of recent years. The size of the towers will be determined according to capacity desired. The practices of carbonization, filtration, calcining and ammonia recovery are well described although local variations occur, of course. In each case both the theory and the operating practice is thoroughly discussed and examples of calculation are given.

Chapters XIV to XVIII deal with byproducts and modified sodas. These are treated less thoroughly than is the manufacture of soda ash, but still with sufficient detail to be valuable guides for the student. On page 203 the remark is made "If caustic mud is to be reburnt, the sludge need not be washed so thoroughly." This may be relative, but the better the mud is washed, the less will be the attack on the refractory lining of the rotary furnace. The paragraph on page 206 referring to NaCl—free caustic, should with more reason have been included in the chapter on electrolytic caustic.

The book will be of value to anyone interested in soda manufacture or use, but to appreciate it fully a rather complete pre-knowledge of the subject is necessary. It is the best book yet published on modern ammonia soda practice.

More Formulae

The Chemical Formulary. Published by the Chemical Formulary Company, Brooklyn, N. Y. 595 pages. Price, $6.

Reviewed by *J. R. M. Klotz*

THE FIRST REACTION to this title may well be, "What! Another?!". But, in this case, scrutiny would seem to indicate that both the publishers and the author have at least endeavored to bring chemical formulae up to date. They have called upon a board of editors which is most comprehensive. By recommending that a chemist be consulted wherever possible, they have sought to avoid one of the great dangers of compendiums of this sort, namely, that getting into the hands of non-technical men, it may cause considerable trouble.

There is an abundance of material covering a very wide variety of items too numerous to give in a short review, but some idea of the scope may be had by mentioning a few of the subjects, viz., adhesives, alloys, antiseptics, bleaches, boiler compounds, carbon paper, castings, cleaners, colors, cosmetics, disinfectants, dyes, emulsions, etching, fireproofing, fuels, glazes, insecticides, inks, lacquers, leather, lubricants, paint, plastics, plating, polishes, soaps, varnishes, and weed killers.

There is one point which we cannot help but feel is a dangerous precedent. That is, in many cases the authors have given formulae and then noted with an asterisk that such formulae are covered by letters patent. We feel that some of the owners of such patents will not relish this publicity on the ground that amateurs and small fry can infringe under circumstances that would be very difficult to check up. We do not, of course, question the legality in such a matter, when the patents themselves are open to the public, but we feel that many manufacturers may feel hurt by having these data thus conveniently assembled.

The book is well indexed, which is an improvement over most compendiums, and will be found a great time saver to those seeking information in the fields it covers.

Applying for a Patent

Preparation and Prosecution of Patent Applications. By *Charles W. Rivise.* The Michie Co., Charlottesville, Va. 484 pages. Price, $7.

Reviewed by *Arthur L. Davis.*

"IT IS THE PURPOSE of this work to present in sufficient detail the necessary information to enable one to prepare an application and prosecute it to the issuance of a valid patent of the broadest possible scope." The layman may find this arrangement of law and procedure instructive or refreshing, since the groupings correspond to the usual papers or actions in cases, except those involving interference. The inventor is urged to select a competent patent attorney with technical experience in the art to which the invention relates, unless his previous experience qualifies him to handle his own application. The patent attorney is thoroughly familiar with most of the procedure and forms presented with the Rules of Practice in the United States Patent Office containing an authoritative statement of the rules of procedure and 47 suggested forms. He will usually obtain a state-

ment of the law most clearly applicable to the set of facts under consideration, by reference to the highest court decisions or quotations from such decisions indicated or quoted in the several patent law digests.

Approximately 400 subjects have been summarized in as many numbered and titled paragraphs. The tabulation of the positive, negative or optional requirements for a considerable number of subjects is a particularly interesting feature of the book. The 16 chapter titles appear in logical sequence but three do not accurately describe their respective contents. The omission of a chapter on interferences is not in keeping with the stated purpose of the author. The term "specification" is used in the narrow sense of description in one chapter while the accepted broader meaning, which includes the description and claims, is used in another chapter. Attention is directed to the decreasing order of importance of product, process and apparatus claims. The discussion of the claims is generously illustrated with quotations of claims which have been adjudicated. Considerable study should be given to the descriptive portion of the specifications containing the reference claims.

The chemist and chemical engineer may find this volume particularly suited for his technical bookshelf.

Mineral Economics

ELEMENTS OF A NATIONAL MINERAL POLICY. By The Mineral Inquiry, *C. K. Leith*, Chairman. Published by American Inst. Mining and Met. Eng., 29 West 39th St., New York. 162 pages. Price, $1.25.

Reviewed by *R. S. McBride*

RAW MATERIAL supply for process industry is exceedingly important. This is significantly affected by many national policies, including those which govern legislation on mineral production, import, export, and trade stimulation or restraint. Hence the subject matter of this book is of wide interest to the chemical engineer having any connection with process industries dealing in or processing minerals.

The volume has been developed from a conference held in New York during 1933 under the joint auspices of the Council on Foreign Relations and the A.I.M.E. At these sessions, attended by a group of economists, engineers, and other specialists in various mineral fields, the purpose was to take up each fundamental factor, not primarily to establish a policy, but rather to develop and clarify principles involved. A bare synopsis resume of the proceedings of these conferences is presented in this small volume.

One wishes that this work could be more complete and detailed; but even in its brief form it is highly suggestive and in many parts constructively helpful to the engineer who has mineral problems to consider.

MINERALS YEARBOOK. Compiled by U. S. Bureau of Mines and published by Superintendent of Documents, Washington, D. C. 819 pages (Cloth). Price, $1.25.

THIS VOLUME represents a more prompt issuing of statistical information about commercially important minerals than has been possible under the old Bureau of Mines plan. The new work is essentially Mineral Resources of the United States with a new title, somewhat condensed in size, and with omission of much of the interpretative text formerly printed. This volume labeled for 1932-33 gives statistics for operations through the calendar year 1932. No figures for the calendar year 1933 are included. The use of the later year designation refers to the date of issue only.

THE PORPHYRY COPPERS. By *A. B. Parsons*. Published by American Institute of Mining and Metallurgical Engineers. 581 pages. Price, $5; to members A.I.M.E., Price, $1.50.

SO MUCH of human interest is related in this fascinating story of America's rise to supremacy in the field of copper that the book should appeal to all members of the engineering professions, and not to the mining engineer and the metallurgist only. The chemical engineer will also find much of value in the description of the hydrometallurgical developments of the great copper producers; crushing, grinding, classification, and leaching operations on an unprecedented scale have been responsible for much of the equipment and technique later widely adopted by the chemical industries.

Metal Progress

THE BOOK OF STAINLESS STEELS. Edited by *Ernest E. Thum*. Published by the American Society of Steel Treating, Cleveland. 614 pages. 200 illustrations. Price, $5.

ALTHOUGH the stainless steels were introduced into the process industries only a very few years ago, their use has spread to practically every one of the group. This rapid expansion in the use of these steels has been accompanied by an equally rapid increase in the knowledge of the methods of fabrication, the control of intergranular corrosion, the resistance to corrosion by chemicals, and the performance at high temperatures. While the many developments have been described in the literature they have never before been gathered together under one cover. It is time that we take stock of these developments and for that purpose get them together as has been done in this volume. This should serve to supplement Speller's contribution on the causes and prevention of corrosion, and Moneypenny's treatise on stainless iron and steel.

The chemical engineer will be directly interested in such chapters as those dealing with uses of stainless steels in the chemical industry, petroleum refineries, paper mills, and in the manufacture of pharmaceuticals and dyestuffs. He will also find much of value in the chapters on such subjects as creep at high temperatures, welding and bi-metal sheets.

THE ALLOYS OF IRON AND SILICON. By *E. S. Greiner*, *J. S. Marsh*, and *Bradley Stoughton*. Published for the Engineering Foundation by McGraw-Hill Book Co., New York. 457 pages. Price, $5.

WITH THIS VOLUME has been completed the second in a series of monographs issued by the Alloys of Iron Research, with the assistance from The Engineering Foundation. More than 1,200 articles, in many languages, have been located and examined, and nearly 500 have been selected for careful study. It is this exhaustive review of all material available on the subject which makes these monographs so valuable to all interested in metallurgy, be they students, operating engineers, or research workers. A number of the most prominent men of the profession hav ealso assisted in the preparation of the text.

METALLURGICAL ANALYSIS BY THE SPECTROGRAPH. By *D. M. Smith*, Published by British Non-Ferrous Metals Research Association, London. 114 pages. Price, 10s.6d.

APPLICATION of spectrographic methods in the analysis of non-ferrous metals and alloys is rapidly coming to the foreground, as the demands in regard to freedom from even minute quantities of impurities are becoming so exacting that the ordinary methods of quantitative analysis are no longer satisfactory.

SYMPOSIUM ON CAST IRON. Published jointly by American Society for Testing Materials and American Foundrymen's Association. 164 pages. Price, $1.

IN THIS SYMPOSIUM the material has been presented under seven broad divisions, including metallurgy, properties, classifications and specifications, heat treatment, white and chilled irons, and welding and foundry factors of importance. The section on metallurgy deals with the effects of normal elements in cast iron, structural components, gen-

eral influence of mass and thermal history in structural make-up, and alloy additions which have such an important influence on the properties of cast iron.

Praktische Metallkunde. Vol. I. By *Georg Sachs.* Julius Springer, Berlin. 272 pages. Price, 22.50 Rm.

IN THE FIRST volume the author treats systematically the more advanced practice in melting and casting nonferrous metals and alloys. Included are chapters on structures; light metals and alloys; gases in metals; the effect of small quantities of impurities; high-temperature work; and mechanical testing, including the latest developments in X-ray analysis. Among the illustrations may be mentioned a series of charts giving the constitutional diagrams for a number of important alloys.

A.S.T.M. Books

Book of A.S.T.M. Standards, 1933. Part I, Metals. 1,002 pages. Price, $7.50. Part II, Non-Metallic Materials. 1,298 pages. Price, $7.50. Both volumes, $14. Published by American Society for Testing Materials, Philadelphia.

SPECIFICATIONS, methods of test, definitions of terms and recommended practices covering engineering materials are dealt with in these volumes which are issued triennially. Part I lists 185 standards, of which 104 relate specifically to ferrous metals, 70 to nonferrous metals, and 11 to metallic materials in general. In Part II are given 283 standards, 60 for cement, lime, gypsum, concrete, and clay products; 219 for miscellaneous materials, such as coal, timber, petroleum, and others; while four standards are general.

A.S.T.M. Standards on Preservative Coatings for Structural Materials (Paints, Varnishes, Lacquers, and Paint Materials). Published by American Society for Testing Materials, Philadelphia. 350 pages.

ALL OF THE A.S.T.M. specifications, methods of test, and definitions pertaining to protective coatings (other than metallic coatings) have been compiled in convenient form in this volume. Some of these specifications, which are given in the existing form at the time of publication, may be changed before they are advanced to actual standards.

Book of A.S.T.M. Tentative Standards, 1933. Published by American Society for Testing Materials, Philadelphia. 1,136 pages. Price, $7.

THE TERM "tentative" applies to a proposed standard published for one or more years with the view of eliciting criticism before it is formally adopted by the Society. Of the 223 tentative standards presented, 34 relate to ferrous and 21 to non-ferrous metals; 45 to cement, lime, gypsum, stone, concrete, and clay products; 113 to miscellaneous products such as paints, petroleum, textiles, while 10 are general methods.

The Romance of Research. By *L. V. Redman* and *A. V. H. Mory.* Century of Progress Series. The Williams & Wilkins Co., Baltimore, Md. 149 pages. Price, $1.

AFTER AN introductory chapter on the philosophy of research the authors proceed to show, by well chosen and interesting examples, the influence of scientific research on the progress of the human race, how research is constantly equipping man with an abundance of new materials, far superior to the old. Finally they appeal for similar efforts in the social sciences in order that society may catch up with material progress and thus permit all to enjoy the benefits of a civilization far beyond present standards.

Chemical Handbooks

Handbook of Chemistry and Physics, Eighteenth Edition. Edited by C. D. Hodgman. Published by Chemical Rubber Publishing Co., Cleveland, 1933. 1,818 pages. Price, $6.

TOPPING OFF 20 years of service to chemists, chemical engineers, and physicists, this useful compilation has again appeared, this time in its eighteenth edition, and bigger and better than ever. Many revisions and additions have been made to correct earlier errors and bring information up to date. Among the most important revisions is that of the table of physical constants of inorganic compounds which has been expanded by nearly a thousand compounds while more recent data have been supplied for compounds previously listed. The metal-organic compounds have been placed in a separate table and their number greatly increased. Descriptive matter on the elements has been rewritten and revised and the important tabulations on thermionic tubes completely reworked in the light of recent developments. Many of the smaller tables have been revised and others added. A new and exhaustive list of photographic film and plate speeds has been included.

Chemical Engineers' Handbook. Prepared by a staff of specialists and edited by *John H. Perry,* Ph.D., Editor-in-Chief, and *W. S. Calcott,* Ch.E., Assistant Editor. Published by McGraw-Hill Book Co., Inc., New York. 2,624 pages. Price, $9.

EDITOR'S NOTE: Twenty-five of the thirty sections that comprise this comprehensive compilation were reviewed in these pages last month (*Chem. & Met.* Vol. 41, No. 2, pages 88 to 91.) The five remaining sections have been reviewed below.

Mechanical Separations (Section XV). By *Anthony Anable, Donald F. Irvin, Kenneth H. Donaldson, Warren L. McCabe, A. E. Flowers, Evald Anderson,* and *J. W. Stillman.* Pages 1,313 to 1,554.
Reviewed by *E. A. Holbrook.*
Dean, School of Mines, University of Pittsburgh

THE VALUE OF a handbook to an engineer is determined, not by the length or the diversity of the descriptions, but by an affirmative answer to the following question: Is it actually useable to an engineer who has a problem to solve? In the sections under consideration therefore, one should be able to find sufficient data to enable him to solve any ordinary problem involving mechanical separation. Accordingly, I selected an actual ore on which I had complete experimental data and for which I wished to lay out a practical flowsheet which should include sampling, crushing, pulverizing, screening, classification, treatment of sands and slimes, separation of dust and use of necessary auxiliary apparatus. I found out that the Handbook stood up under this test and that from its descriptions and data I could lay out my proposed plant.

For example, the chapter on Filtration not only describes fully the several types and makes of filters so that the proper filter can be selected for the work at hand, but it gives sufficient operating data so that difficulties in filter operation may be avoided. Even pumps and other necessary auxiliaries are considered. In the other chapters reviewed there is the same complete but concise information.

I gave the sections another test. Are they up to date or are they a compilation of older material? I found very recent data on classification and sedimentation. The newer types of vibrating screens are described and followed by four pages of operating data. In the section on pulverizers are given the newest applications of this machinery.

Altogether, the section on Mechanical Separation is complete, up-to-date, and useable. In no other work have I seen the machinery and apparatus originally designed for ore dressing projected into such a wide variety of industrial processes. It will be of first hand service in the wide field of chemical engineering activity.

Movement and Storage of Materials (Section XX). By *G. L. Montgomery.* Pages 1,807 to 1,896.

Power Generation and Mechanical Power Transmission (Section XXII). By *A. D. Blake, R. B. Purdy,* and *William Staniar.* Pages 2,009 to 2,095.
Reviewed by *P. W. Swain,*
Editor of Power

THIS SECTION of the Chemical Engineers' Handbook on Movement and Storage of Materials discusses separately the movement of solid materials, liquids, gases and vapors and the storage of materials. Under

each of these headings various equipment is described and illustrated.

Twelve tabulations are given showing various methods of conveying solid materials under varying conditions of quantity and type of flow, in each case indicating the most usually selected type of conveyor for handling the particular conditions. Requirements peculiar to the chemical industry due to corrosion, heat, fire or explosion, poison and sanitation are discussed.

Data are also given on the capacity, power consumption and dimensions of various types of conveyor machinery.

Under "movement of liquids" are included data on centrifugal, reciprocating, rotary, air lift and ejectors, together with a brief discussion of centrifugal pump theory. Fans, rotary blowers, turbo-compressors and reciprocating compressors are discussed under "movement of gases."

The first part of Section XXII covers briefly the generation of power by steam engines, steam turbines, oil engines, and hydro turbines. The authors have stressed the possibilities of byproduct power generation with which the chemical engineer is most likely to be concerned. No attempt has been made to provide sufficient data for power plant design but rather to acquaint the chemical engineer in a general way with present power plant practice and performance. Although power plant costs are given as of 1931, they should be used with caution because of rapidly changing market conditions.

The second part covers mechanical transmission by belt, chains, shafting, ropes and reduction gears. Under belts are discussed the characteristics of various types of belts, their care and treatment, short center drives and pulleys.

Various types of reduction gear units and variable-speed mechanisms are described, together with a discussion of clutches. It is somewhat surprising that the author has not included the flexible coupling in his presentation of this subject.

REPORTS AND REPORT WRITING (Section XXIX). By *Fred C. Zeisberg*. **Pages, 2,521 to 2,527.** PATENTS AND PATENT LAW (Section XXX). By *Edwin J. Prindle.* Pages, 2,529 to 2,569.

Reviewed by *Albert E. Marshall, President, American Institute of Chemical Engineers.*

SEVERAL years' experience as Chairman of the Committee on Publications of the American Institute of Chemical Engineers, and much reading of departmental reports, has given Mr. Zeisberg a vantage point for his discussion of satisfactory forms of reports.

Report practices in research chemical laboratories are quite divergent, and it is often a matter of great difficulty for a new employee to adapt himself to a system of continuous weekly reports when his previous experience involved the preparation of running notes and a final systematic report. Mr. Zeisberg discusses the difficulties inherent in the various report systems, and expresses a preference for monthly reports followed by a final report.

Dealing with report forms, the author suggests an arrangement of introduction, historical state of the art, the research itself and the summary and conclusions. There are few research reports which do not lend themselves to this treatment, and a more general standardization along these lines would simplify studies of reports.

The author also discusses process reports and surveys, and again drawing on his long experience makes some pertinent comments and suggestions. One really useful admonition to report writers comes at the conclusion of Mr. Zeisberg's chapter. It is "Write for the sake of the matter and not for the sake of the writing."

In 38 pages Mr. Prindle has presented a concentrate of U. S. patent laws which will be invaluable to the chemical plant executive, superintendent and research worker. Here, in a few pages, will be found the answer to the often asked questions "Is it patentable?" and "What is the dividing line between old and new art?"

The extent of the monopoly conferred by the granting of a patent is discussed and infringement and the various defenses against an infringement suit are clearly illustrated by carefully selected citations. The patent relations of employer and employee are defined, and the decision of the Supreme Court in United States *vs.* Dubilier Condenser Corporation is extensively quoted. The importance of this decision to the chemical industry is emphasized, and its effect on employee agreements and contracts analyzed. Mr. Pringle **has performed** a real service by condensing into one chapter a patent law summary, free of legal terms, and previously not available in less than a "five-foot bookshelf."

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Statistics Concerning Intoxicating Liquors, December, 1933. Bureau of Industrial Alcohol, unnumbered pamphlet; 10 cents.

Marketing Agreement for the Distilled Spirits Industry; License for the Distilled Spirits Industry. Agricultural Adjustment Administration Agreement No. 27, License No. 21, Form M-36; 5 cents.

Marketing Agreement for the Alcoholic Beverages Importing Industry; License for the Importers of Alcoholic Beverages. Agricultural Adjustment Administration Agreement No. 25, License No. 19, Form M-33; 5 cents.

An Outbreak of Dermatitis Among Workers in a Rubber Manufacturing Plant, by Louis Schwartz and Louis Tulipan. Public Health Service Reprint No. 1584; 5 cents.

Dermatitis From Chemicals Used in Removing Velvet Pile, by Louis Schwartz and Louis Tulipan. Public Health Service Reprint No. 1586; 5 cents.

Zinc in Relation to General and Industrial Hygiene, by Cecil K. Drinker and L. T. Fairhall. Public Health Service Reprint No. 1589; 5 cents.

Wages and Hours of Labor in Glass Industry, 1932. Bureau of Labor Statistics, Serial No. R. 42 (from Monthly Labor Review, October, 1933).

Accident Experience in Iron and Steel Industry to End of 1932. Bureau of Labor Statistics, Serial No. R. 37 (from Monthly Labor Review, October, 1933).

Studies of Fluorine Compounds for Controlling the Codling Moth, by E. J. Newcomer and R. H. Carter. Department of Agriculture Technical Bulletin 373; 5 cents.

The Flow of Water in Flumes, by Fred C. Scobey, Department of Agriculture, Technical Bulletin 393; 15 cents.

Sugar-Cane Sirup Manufacture, by H. S. Paine and C. F. Walton, Jr., Department of Agriculture, Department Bulletin No. 1370; 10 cents.

The Climax Molybdenum Deposit in Colorado, by B. S. Butler and J. W. Vanderwilt, U. S. Geological Survey Bulletin 846-C; 50 cents. Contains also a section on history, production, metallurgy, and development, by C. W. Henderson.

Iron Oxide Mineral Pigments of the United States, by Hewitt Wilson. Bureau of Mines, Bulletin 370; 15 cents.

Geology of the North and South McCallum Anticlines, Jackson County, Colorado, with Special Reference to Petroleum and Carbon Dioxide, by J. C. Miller. U. S. Geological Survey, Circular 5; mimeographed.

Limestone—Part II, Dimension Stone, by Oliver Bowles. Bureau of Mines Information Circular 6756; mimeographed.

Mineral Statistics, 1932-33. Statistical appendices supplementing Minerals Yearbook, 1932-33, printed as separates by the Bureau of Mines for: Gypsum; Ore Concentration; Clay; Stone; 5 cents each.

Mineral Production Statistics for 1933—preliminary mimeographed statements from Bureau of Mines on: Lime; manganese ore; copper, lead and zinc mining; slate; lime; aluminum.

Portland Cement in December, 1933, and *Summary of Estimates by Months and by Districts in 1933.* Bureau of Mines Cement Statement C.P. 151; mimeographed. This statement, one of a monthly series issued by the Bureau of Mines, gives a preliminary annual summary.

Production and Stocks of Coke. Bureau of Mines, Monthly Coke Report 70; mimeographed. This statement, one of a monthly series issued by the Bureau of Mines, gives a preliminary annual summary of coke production in 1933.

Production, Consumption, and Stocks of Fats and Oils, Fourth Quarter, 1933. Bureau of Census, preliminary report; mimeographed.

Tennessee Valley Authority, General Information. Tennessee Valley Authority; mimeographed. A convenient form of reference information for those anticipating dealings with this agency.

Other Washington Publications

Convention Dates of Trade Associations. Chamber of Commerce of the United States, Washington, D. C.; mimeographed. Dates and places of meeting of conventions to be held by trade associations.

Report of Experimental Work on the Hydrogenation of Canadian Coal, Coal Tar, and Bitumen for the Production of Motor Fuel, by T. E. Warren and A. R. Williams. Department of Mines, Canada, Ottawa, Canada.

Proceedings of the Ninth Annual Convention of the National Fertilizer Association, White Sulphur Springs, W. Va., June, 1933. National Fertilizer Association, 616 Investment Building, Washington, D. C.

A History of the National Research Council, 1919-1933. Reprint and Circular Series No. 106; 50 cents. National Research Council, Washington, D. C.

Classification of Coals Using Specific Volatile Index, by E. J. Burrough and others. Department of Mines, Canada, No. 725-2.

A Laboratory Test on Coals for Predicting the Physical Properties of the Resultant By-Product Coke, by E. Swartzman and others. Department of Mines, Canada, No. 737-2.

PLANT NOTEBOOK

NOMOGRAM FOR SOLVING PERCENTAGE CONVERSIONS OF BINARY MIXTURE COMPONENTS

By Temple C. Patton
Department of Physics
Massachusetts Institute of Technology
Cambridge, Mass.

A FREQUENT need in chemical engineering calculations is the conversion of the percentage of either component in a binary mixture, expressed on a weight, volume, or molal basis, to another of these three bases. Such a conversion, if it is to be carried out with any frequency, is unnecessarily time consuming, although the calculation itself is not difficult. Two charts have been developed in a recent article (*Chem. & Met.*, Vol. 39, 1932, p. 673) to expedite these conversions. However, they are subject to three criticisms. First, they involve the calculation of a weighting ratio; that is, the charts are not self-contained, but necessitate outside arithmetical computation. Second, they are of that type of chart which requires interpolation between curves and straight lines with attendant sacrifice in accuracy. Third, the final charts are complex in their makeup.

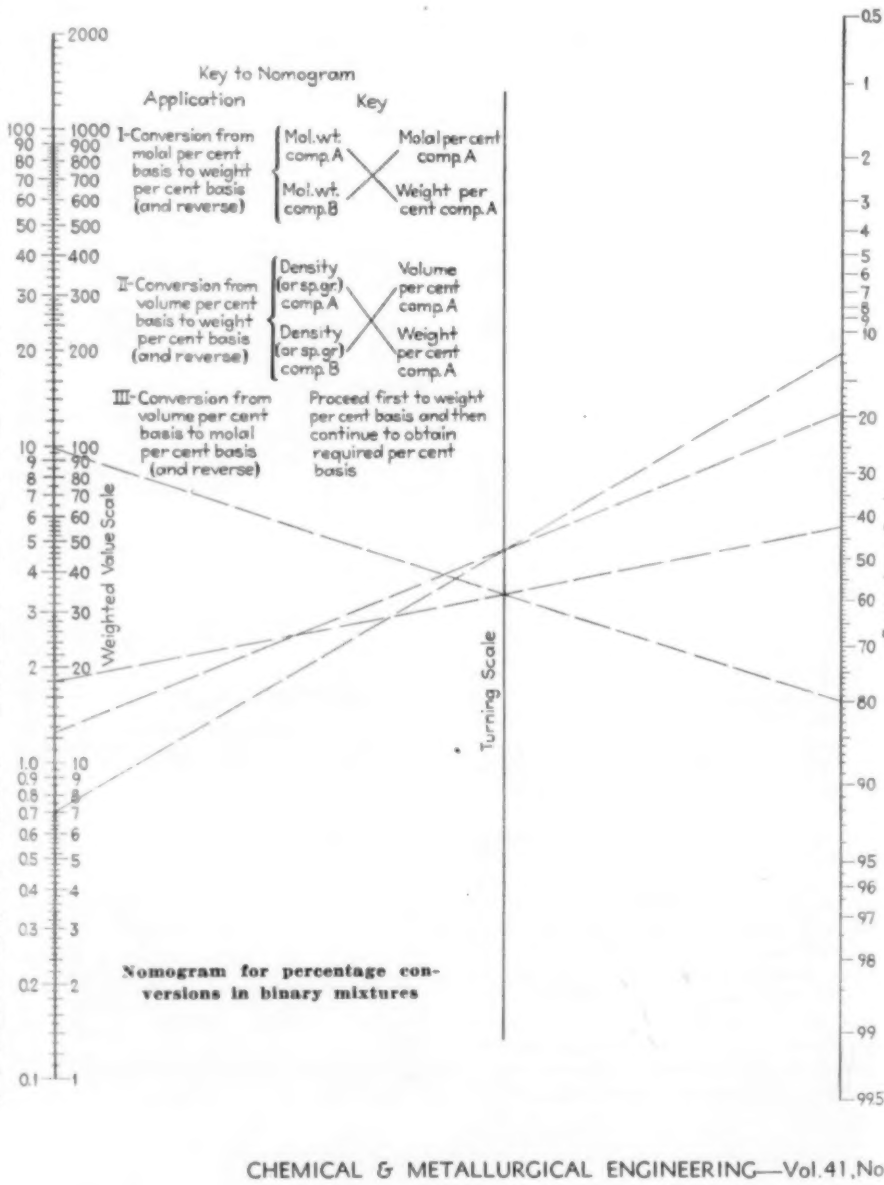
The attending nomogram is presented with the purpose of eliminating these faults. The nomogram scales are straight, simply graduated, and three in number. No outside computation is required. The solution to any problem is obtained by the use of two straight lines, mutually crossing each other at the center (ungraduated) nomogram scale, and intersecting the outside scales at values which represent the problem under consideration. Interpolation along each scale is readily and accurately made.

The key as given on the nomogram consists (1) in connecting by a straight line the known percentage of the first component (on percentage scale) with the "weighted value" (molecular weight, density or specific gravity) of the second component (on weighted-value scale) to intersect the center turning scale; (2) in drawing through this intersection on the turning scale another straight line to connect the "weighted value" of the first component (on weighted-value scale); (3) in extending this straight line to intersect the percentage scale at a value which represents the required percentage of the first component on the new basis.

The keys given are sufficient to make a percentage conversion involving a binary mixture from any one of three bases (molal, weight, or volume) to any other at will.

Either range on the "weighted-value" scale may be used, subject to the limitation that in the solution of any one problem, consistent use is made of the range selected. The choice of range is arbitrary. For example, the range from 1 to 2,000 is usually employed for molecular weight values, while that from 0.1 to 100 is generally used for specific gravity or density values.

In the two examples solved by the lines on the nomogram the first represents the case of conversion from the molal to the weight per cent basis. Component *A*, with a molecular weight of



Nomogram for percentage conversions in binary mixtures

18 is 80 per cent on the molal basis. Component B has a molecular weight of 98. The solution shows the weight per cent of component A to be 42.3 per cent. In the second example, the conversion is from the volume to the weight per cent basis. Component A, of density 1.25, is 12 per cent on the volume basis. Component B has a density of 0.7. The crossed lines show the weight per cent of component A to be 19.6 per cent.

By analogy with the types of conversion given on the nomogram, it can be shown that any formula of the type

$$A' = \frac{AW_A}{AW_A + BW_B}$$

can be solved through the appropriate use of the nomogram. (Here A' = weighted percentage component A; A and B = unweighted percentages of components A and B; and W_A and W_B = weighted values of components A and B.)

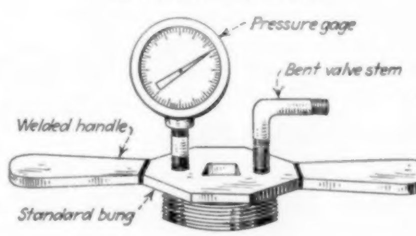
Air Testing Device for Steel Drums

By Louis E. Brunner
Factory Superintendent
Continental Carnavar Corp.
Brazil, Ind.

MANY CHEMICAL PLANTS follow the practice of returning their steel drums to the factory at intervals, for cleaning and repainting. It has been my experience, when the drum is not tested before this occurs, that the cost of cleaning and repainting will often be wasted, for many such drums will be found to have developed leaks, usually a fine crack around the rim or in the welded seams. The crack probably results from rough handling in transit and will generally be so small that it is not detected until the drum has been refilled, ready for another trip.

In the accompanying sketch I have shown a simple and inexpensive homemade device through the use of which air pressure can be put on the drum. It consists of a standard 1½-in. bung to which a pair of handles is welded. Two ¼-in. holes are drilled and tapped into the bung, one for a pressure gage and the other for an ordinary bent-stem tire inflating valve. Using this device before a drum is cleaned and repainted, we put it under 10 lb. air pressure. If it will hold this pressure for some time we are reasonably certain that the drum is worth reconditioning.

Air tester for drums



Dangerous Fallacy in Computing Packed Towers

By C. W. Selheimer, Jr.
Cincinnati, Ohio

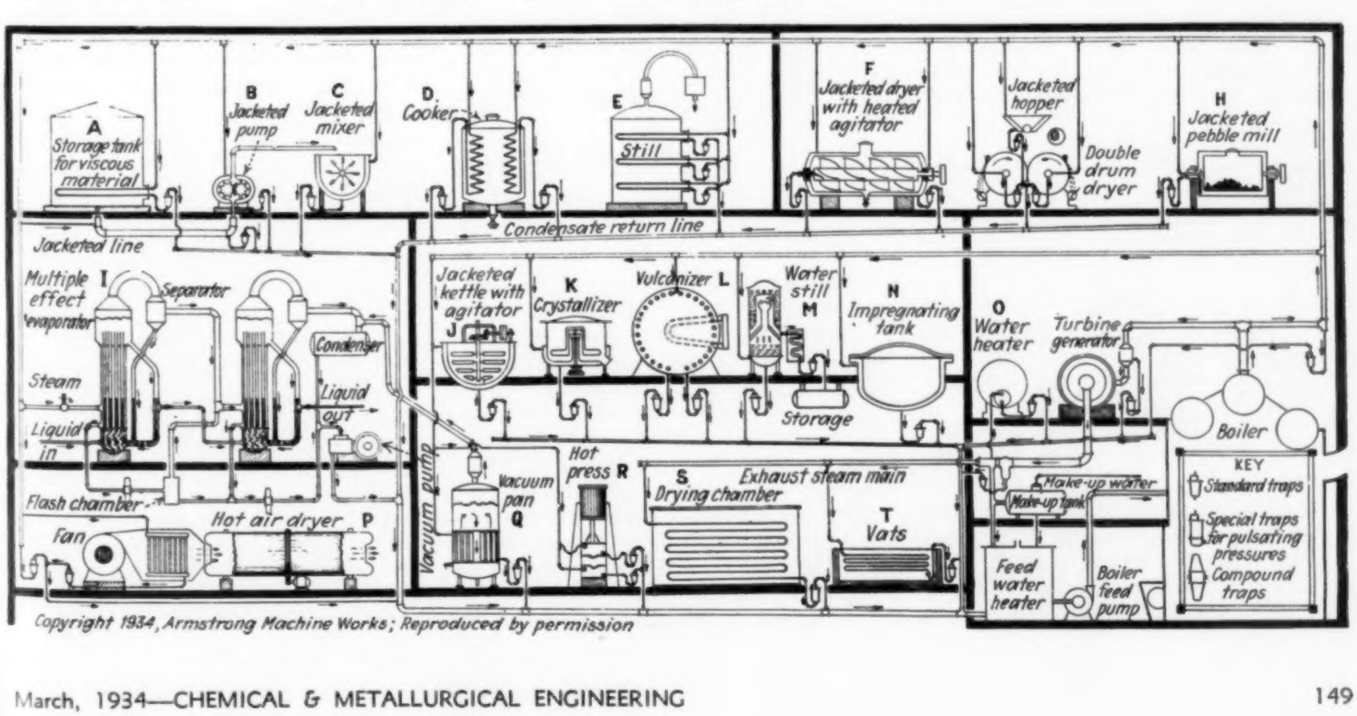
A METHOD often used in the design of a packed tower is to construct and test a small one, and then make a plant installation, basing the calculations upon the work done by the experimental tower. But to assume that the conditions existing in the experimental model are the same as in the plant installation is to take a great risk, for in a packed tower of relatively small diameter the vertical wall surface plays a most important part.

In an experimental tower 4 in. in diameter and 20 ft. tall, packed with moderately small quartz or small ceramic shapes dumped at random, 85 to 98 per cent of the liquid passing through the tower was collected from the wall surface at the bottom of the tower, the small remainder of the liquid being collected from the packing. Clearly, the vertical wall surface was doing most of the work. If calculations were based on the assumption that the liquid was passing through the packing, they would be greatly in error, and would result in the failure of a plant installation to function as desired. To be safe, the diameter of the proposed installation should never be more than ten times the diameter of the experimental tower.

Composite Diagram of Chemical and Allied Equipment Showing Some of the Uses of Steam Traps

(Reproduced by permission, with slight modifications, from a chart developed by the Armstrong Machine Works, Three Rivers, Mich.)

Chemicals: A, B, C, D, E, F, G, H, I, J, K, M, O, P, Q, R, S, T
Coke Byproducts: A, B, E, J, K, P, Q
Drugs and Cosmetics: C, E, F, G, I, J, K, M, O, Q, S, T
Explosives: E, F, O, S, T
Fertilizer: F, O, P, Q, T
Gelatin and Glue: D, G, M, O, Q, S, T
Oils and Greases: A, B, D, E, J, R, T
Paints and Varnishes: F, G, J, P, S
Paper and Pulp: D, I, J, O, S, T
Plastics: A, B, C, E, J, L, N, R
Rayon: E, O, S
Rubber: C, L, R, S
Salt: I, P, Q, T
Soap: A, B, C, E, G, J, O, S, T
Sugar: I, O, P, Q, S, T
Wood Treating: A, B, N, S



NEW EQUIPMENT

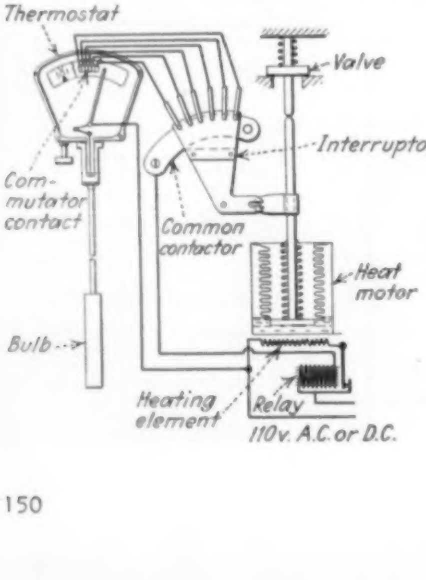
Electric Temperature Regulator

Close throttling temperature regulation, without the use of auxiliary fluid pressure, is attained according to the manufacturers by a new electric temperature regulator introduced by the Wilbin Instrument Corp., 40 East 34th St., New York City. The new instrument comprises in combination a fluid-operated thermostat, an electrically-heated pressure motor, and a control valve. In the industrial type, shown diagrammatically in the accompanying sketch, pressure in the liquid-filled bulb of the thermostat controls the closing of the commutator type contact, through a flexible bellows. The bellows also positions a pointer on an indicating temperature scale.

When the instrument is set in operation, the heat motor, which is attached to the control valve and is itself controlled by a mercury switch relay, is connected to the lighting circuit. This vaporizes a portion of the liquid, causing the valve to open. When full open, the normally closed relay is mechanically opened so as to cool the pressure chamber and permit the valve to float at a nearly open position until the bulb temperature has risen far enough to bring the thermostat contact to the commutator. When the temperature approaches the control point the moving contact touches the first commutator segment and opens the relay, allowing the valve to travel downward one-sixth of its stroke. At this point the interruptor closes the relay, causing the valve to hold this throttling position. Should the temperature continue to rise, the next contact will be made, opening the relay and causing the valve to close another sixth of its stroke.

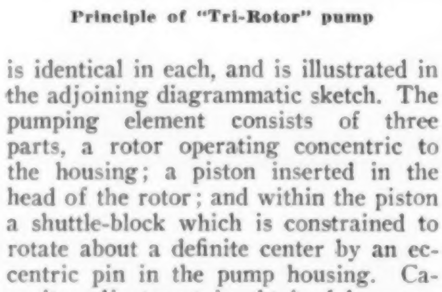
Thus the valve will throttle in six different positions, and will travel from full-open to full-closed on a change of 1 deg. F. at the thermostat. The instrument eliminates practically all moving parts and is said to be suitable for controlling wide and varying temperature fluctuations. It is available in control ranges from —40 to +650 deg. F.

Diagram of electric temperature regulator



Non-Pulsating Pump

A new principle in rotary pump construction has been introduced in the "Tri-Rotor" made by the Yale & Towne Mfg. Co., Stamford, Conn. Although this pump is built in various styles for various purposes, the pumping principle is identical in each, and is illustrated in the adjoining diagrammatic sketch. The pumping element consists of three parts, a rotor operating concentric to the housing; a piston inserted in the head of the rotor; and within the piston a shuttle-block which is constrained to rotate about a definite center by an eccentric pin in the pump housing. Capacity adjustment is obtained by moving the eccentric pin to give an infinite number of capacities from zero to the maximum for the pump in question.



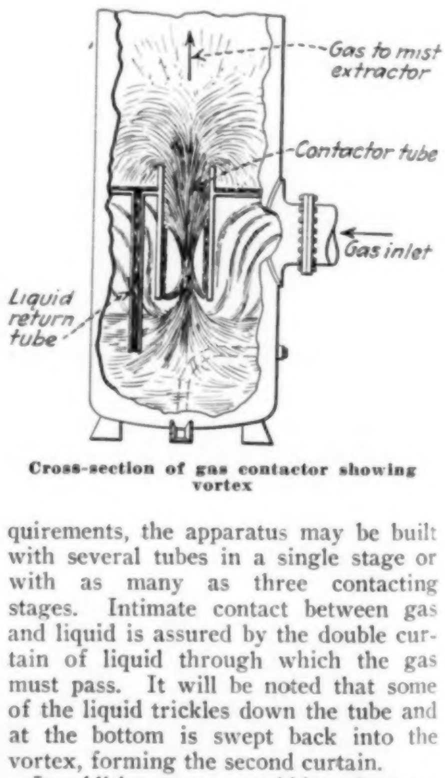
Principle of "Tri-Rotor" pump

In operation, it will be observed that rotation of the rotor produces reciprocating motion in both the piston and shuttle-block, giving four displacement impulses per revolution. The piston displaces from the face of the rotor and the shuttle-block through ports in the rotor. The land area is so designed that the discharge impulses overlap, thus eliminating line pulsations.

Depending upon type and service, this pump is available in sizes to 100 g.p.m.

Gas Contactor

Developed originally for the washing of fuel gases and used later for desuperheating steam, a device introduced by the Blaw-Knox Co., Pittsburgh, Pa., is now being supplied in modified form for gas and liquid contacting. The unique feature of this device is its production of a water spout of liquid as the gas, sweeping downward over the surface of the liquid, passes rapidly up through the contacting tube or tubes. The cross-sectional drawing shows the operation of a single tube. Depending on requirements, the apparatus may be built with several tubes in a single stage or with as many as three contacting stages. Intimate contact between gas and liquid is assured by the double curtain of liquid through which the gas must pass. It will be noted that some of the liquid trickles down the tube and at the bottom is swept back into the vortex, forming the second curtain.

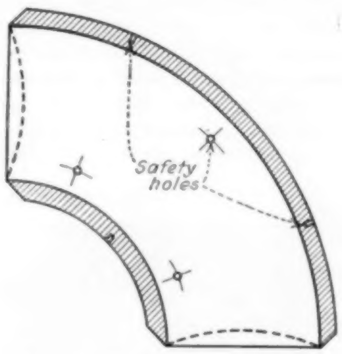


Cross-section of gas contactor showing vortex

In addition to gas scrubbing, desuperheating and gas cooling, the apparatus is being employed for gas and air hydration and for oxidation, chlorination, aeration and similar problems. It has also been used in absorption where not more than three stages of contacting are required. Among the advantages claimed for it are the following: No moving parts; self-cleaning; gas velocities not critical; high capacity; high efficiency mist extractors used at the discharge; and fabrication from any suitable corrosion-resisting material.

Safety-Drilled Fittings

To reduce the hazards of failure due to corrosion and erosion in fittings used in stills, condensers, economizers and other equipment, Tube-Turns, Inc., Louisville, Ky., has put on the market a line of its weld elbows and return bends which are drilled at carefully calculated intervals around the periphery of the fitting, to a depth determined by the operating conditions under which the fitting is to be used. When the fitting has corroded to a point where the wall thickness is reduced to approxi-



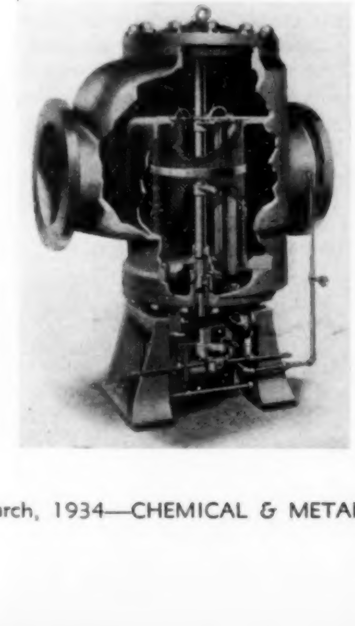
Cross-section of safety-drilled Tube-Turn

mately its safe limit, one or more of these holes is exposed and a small leakage occurs, warning the operator that the fitting should be replaced as soon as possible.

Self-Cleaning Strainer

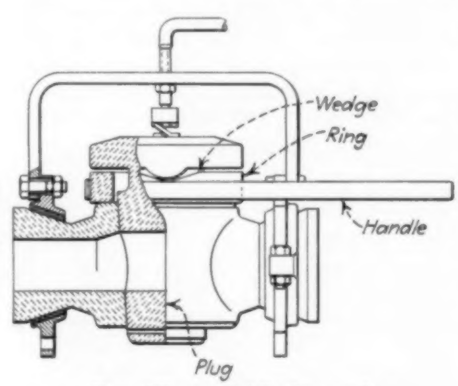
Using the pressure of the water to operate the self-cleaning device is an important feature of a new self-cleaning strainer announced by the Elliott Co., Jeannette, Pa. Construction is evident from the accompanying illustration. Water passes into the three-ply screen basket and out through the screen to the discharge. Some of the water is passed through a water motor which continuously rotates the cleaning device. The latter, shown at the right of the screen, is a V-shaped trough opening to the atmosphere. Water which has been screened back-washes the collected material into this trough and carries it from the strainer. 10 to 12 per cent of the water is used for back-washing and an almost negligible quantity for the water motor. Such strainers are built in sizes from 4 to 24 in., for 125-lb. working pressure.

Cutaway view of self-cleaning strainer



Improved Ceramic Cock

Wedging action, designed to release the plug and avoid sticking, has been employed in a new chemical stoneware acid plug cock by the General Ceramics Co., 71 West 35th St., New York City. Construction of the new design is indicated in the accompanying drawing. Inserted between the top of the plug and the body of the cock is a ring containing two diammetrically opposed de-

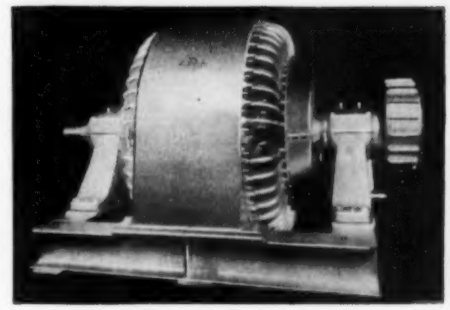


New "Neverstick" plug cock

pressions which register with projections on the plug top. The turning handle is attached to this ring and when the plug is to be turned, the first effect is to lift it slightly and so release it. As soon as release has been accomplished, the plug turns without further lifting, so that the cock is said to remain tight at all times.

Flexible Coupling

Rubber as the flexing medium is employed in a new flexible coupling recently announced by the Morse Chain Co., Ithaca, N. Y. This coupling, the Morflex, employs four molded non-cold-flow rubber trunnion blocks spaced 90 deg. apart and set under pressure into a two-piece riveted steel housing. The diammetrically opposed blocks are bolted respectively to the driving and driven flanges so that all metal parts are rigid and all relative motion confined to the rubber. Among advantages are mentioned the fact that the coupling is noiseless, operating without power loss even under maximum misalignment, and that it requires no lubrication.



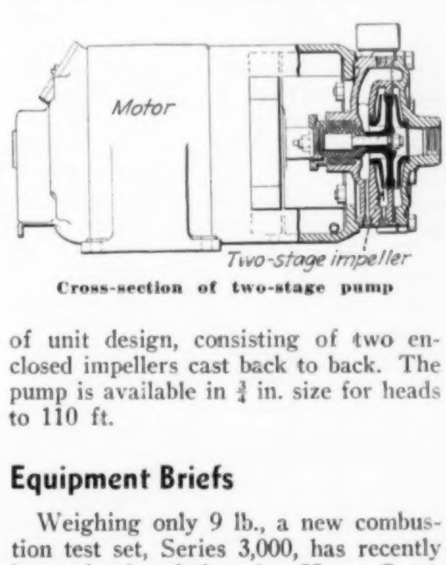
Totally inclosed synchronous motor

Inclosed Synchronous Motor

The accompanying view shows a new design of totally inclosed fan cooled synchronous motor designed for use in corrosive atmospheres and developed by the Electric Machinery Mfg. Co., Minneapolis, Minn. The motor exterior is treated to prevent corrosion and the interior cooled by recirculation of air. These motors are available in practically all horsepower and speed ratings to meet any kind of corrosive atmosphere condition.

Two-Stage Pump

Something new in close-coupled pumps is a two-stage Monobloc centrifugal pump announced by the Worthington Pump & Machinery Corp., Harrison, N. J. Construction is indicated in the drawing which shows the impeller to be



Cross-section of two-stage pump

of unit design, consisting of two enclosed impellers cast back to back. The pump is available in ¾ in. size for heads to 110 ft.

Equipment Briefs

Weighing only 9 lb., a new combustion test set, Series 3,000, has recently been developed by the Hays Corp., Michigan City, Ind. The set, which is housed in a metal carrying case, comprises a CO_2 analyzer and a pointer-type draft gage. A flue gas thermometer may be supplied if desired.

Armite Laboratories, 1450 East 61st St., Los Angeles, Calif., has announced two recent developments. One is a new pump packing and gland lubricant, insoluble in carbon tetrachloride, for use in pumps handling this material. The

other is a thread seal and lubricant comprising in combination very finely divided lead and a lubricating compound suitable for use at high temperatures. Should the temperature encountered be high enough to burn out the lubricant, the lead remains in the thread, permitting easy disassembly of the joint.

Barnstead Still & Sterilizer Co., Forest Hills, Boston, Mass., has developed a new water still lined with block tin for producing what is said to be the purest water ever made. The water has an extremely low conductivity and is used for conductivity and solubility work.

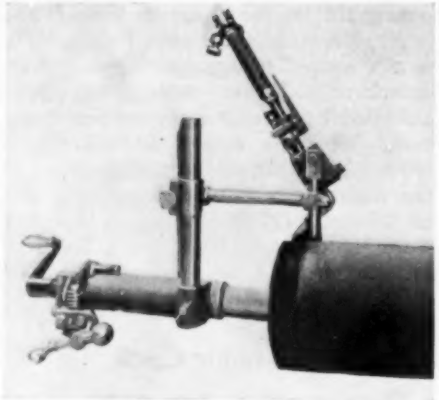
Easy handling of carboys under adverse floor conditions is assured by a new pneumatic-tired carboy truck recently put on the market by Lewis-Shepard Co., Watertown, Mass. In operation, a foot lever is used to spread apart the carrying arms which support the carboy on its cleats.

For use on new machines and for the modernization of old ones, the American Tool & Machine Co., Hyde Park, Boston, Mass., has introduced an improved type of discharger for centrifugal equipment. The plough is raised and lowered by a handwheel and its radial motion controlled by a lever which remains always at the curb level. The new discharger was designed on the basis of motion studies.

For the removal of oxygen as well as calcium and magnesium salts from boiler waters, D. W. Haering & Co., 3408 East Monroe St., Chicago, Ill., has introduced a number of new organic treatments included under the general name of H-O-H series D formulas. These consist of beta glucoside and sodium glucosate. The exact formula supplied is adjusted on the basis of specific water analysis. The materials are highly concentrated.

For laboratory and small-scale industrial use, the Sharples Specialty Co., 23d and Westmoreland Sts., Philadelphia, Pa., has redesigned its laboratory Super-Centrifuge along the lines of its full scale machines. Drive may be either by steam or compressed air turbine or by electric motor. The former operate at 50,000 r.p.m. and the latter at 25,000 r.p.m.

"Hypressure Jenny," Homestead Valve Mfg. Co.'s high-powered sprayer for hot cleaning, paint-stripping and sterilizing solutions, is now being made at the company's Coraopolis, Pa., plant in a new 1934 type known as Model D. The machine is of unit construction, compact and fully automatic. The motor driving the oil and solution pumps operates from a light socket. Both motor and fuel-oil burner start and stop automatically with the operation of the spray nozzle. The density and spray pressure are independently and immediately under control.



New cutting and beveling machine

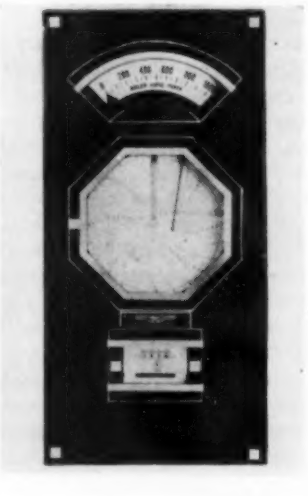
Pipe-Cutting Machine

For cutting and beveling the ends of pipe, the Linde Air Products Co., 30 East 42d St., New York City, has developed a new pipe-cutting and beveling machine constructed as shown in the accompanying illustration. A center rod with three spreading arms centers the device within the pipe, holding it in position and supporting a blow-pipe which can be adjusted to the desired angle of cut. A crank is used to rotate the blowpipe during the cutting.

Sealed-Element Flowmeter

Although the basic principle of operation is practically identical with that of its earlier products, the new line of flowmeters recently introduced by Republic Flow Meters Co., 2240 Diversey Pkwy., Chicago, Ill., is completely redesigned both from the standpoint of appearance and in the method of assembling the actuating elements. The new design is built around a so-called cartridge-sealed element. This element consists of the actuating unit built into a metal cartridge which is mounted on the instrument panel. The three types of reading instruments, the indicator, the recorder and the integrator, are each mounted in separate and distinct cartridge-sealed elements which are interchangeable and easily removed from the back of the panel. The model of meter shown in the accompanying illustration incorporates the company's new CS-24 boiler horsepower indicator which is easily read at a distance.

Meter with cartridge-sealed elements



Adjustable Timing Contactor

Type 1290 is the designation of a new timing contactor for plant operation recently added to the line of the Automatic Temperature Control Co., 34 East Logan St., Philadelphia, Pa. Power is obtained from a reversing synchronous motor, and the contact arm moves alternately clockwise and counter-clockwise within the time limit set, connecting and disconnecting a 10-amp. load circuit at either extreme of its travel.

New adjustable timing contactor

Two-Speed Reducer

What is said to be the first changeable speed industrial gear unit using quiet helical gears and anti-friction bearings throughout, has recently been added to the motorized-speed-reducer line of the Falk Corp., Milwaukee, Wis. The new unit employs this company's standard U Motoreducer housing on which may be mounted any standard-dimensioned motor. Although the speed change cannot be made under load, a wide range of possible high and low speeds is obtainable. For example, with a No. 34 Motoreducer driven by a 1,750-r.p.m. motor, high speeds of from 155 to 583 are obtainable with low speeds from 36 to 247 r.p.m.

Improved Pressure Gage

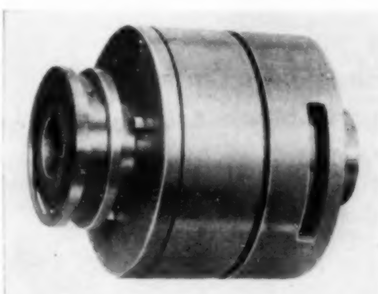
Phenolic resin molding compound is employed in the acid- and moisture-proof case of a new pressure gage recently introduced by the Consolidated Ashcroft Hancock Co., Bridgeport, Conn. In addition to the permanent character of the case, it is pointed out

Pressure gage with molded case

that its weight is much less than that of a cast-iron or cast-brass case. Available sizes range from 4½ to 8½ in. dial size and pressures from 15 to 600 lb.

Magnetic Disk Clutch

Small multiple disk magnetic clutches ranging in diameter from 6 in. to larger sizes, for both wet and dry operations, are included in a new line announced by the Magnetic Mfg. Co., Milwaukee,



Multiple disk magnetic clutch

Wis. The new clutches carry the designation, Style C, and are said to be the first capable of use in both wet and dry operations. According to size, the clutches employ from two to eight disks.

Viscosity Regulator

For controlling the viscosity of such materials as fuel oil, lacquers, varnishes and other coatings, lubricating oils, sizes, printing inks, adhesives and other materials, the Merritt Engineering & Sales Co., Lockport, N. Y., has introduced a new tank-type viscosity regulator consisting of a slowly rotating paddle within a tank, the paddle being driven through a special transmission operating a dilution valve. Any increase or decrease in viscosity is measured by the transmission and this impulse is used to adjust a needle valve to decrease or increase the flow of thinning solvent. In most cases, according to the manufacturer, the viscosity can be controlled within 2½ per cent of that for which the regulator is set. The instrument may also be used for indicating and recording the viscosity of process solutions.

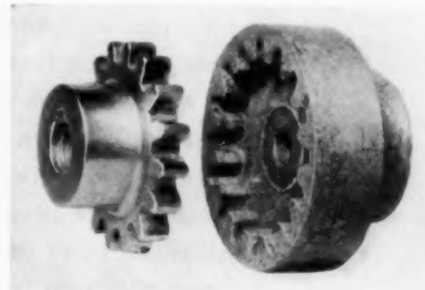
Thermodynamic Steam Trap

Coe Manufacturing Co., Painesville, Ohio, has announced the Coe Drainator, a device which accomplishes the same purposes as a steam trap but which has no moving parts. It is said to employ the thermodynamic properties of hot water to regulate the flow with a pulsating action occurring at such high frequency so as to give a continuous discharge of condensate. The device consists of a number of chambers in series between two of which is a special type of orifice through which the hot water expands into steam. This steam then recondenses and is forced as liquid from the apparatus. The device is said to have high overload capacity and to discharge cold condensate at a much higher rate than during normal operation. It cannot air-bind and requires no air vents or bypasses.

Sprocket Coupling

Macerated Celoron is the material used in the female end of a new sprocket-type coupling announced by the Continental-Diamond Fibre Co., Newark, Del. The metal sprocket is completely enclosed by the Celoron portion so that there are no projections to cause possible danger. The coupling is extremely light in weight, serves as an electrical insulator between motor and driven machine and is available in seven sizes for carrying up to 85 hp.

Two-piece Celoron coupling



MANUFACTURERS' LATEST PUBLICATIONS

Apparatus. American Instrument Co., 774 Girard St., N.W., Washington, D. C. —Bulletins 131 and 146—2 pages, each, on improved equipment and accessories for A.S.T.M. and other tests for preformed gum, gum stability and Reid vapor pressure.

Apparatus. Bausch & Lomb Optical Co., Rochester, N. Y.—6 pages describing the Fitz Micro Manipulator.

Bearings. New Departure Mfg. Co., Bristol, Conn.—128-page general catalog, 9th edition, giving dimensions, load data and list prices on this company's ball bearings.

Carbon Dioxide. Carbondale Machine Co., Carbondale, Pa.—Two 4-page bulletins, one on the regeneration of carbon dioxide in breweries and the other on a storage system for such gas.

Cements. Pen-Chlor, Inc., Widener Bldg., Philadelphia, Pa.—Booklet 1—16 pages on this company's Penchlor acid-proof cement; also folder describing properties and application of this company's Asplit acid-proof cement.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. —L. 20530-B—4 pages on explosion resisting motors for Class 1 Group D hazardous locations; L. 20604, 5, 6, describe fractional horsepower motors.

Equipment. Link-Belt Co., 910 South Michigan Ave., Chicago, Ill.—Book No. 1240—64-page catalog with engineering data on equipment for handling, washing and sizing non-metallic minerals.

Equipment. Robinson Mfg. Co., Muncy, Pa.—Bulletin 50—12 pages on equipment for handling, cleaning, milling and sifting grain in distilleries.

Furnaces. W. S. Rockwell Co., 50 Church St., New York City—Bulletin 346 —2 pages describing a portable heat-treating and carburizing furnace.

Gears. Poole Foundry & Machine Co., Baltimore, Md.—302-page catalog of machine-molded gears listing about 10,000 sizes, kinds and types.

Industrial Flooring. Continental Asbestos & Refining Co., 1 Madison Ave., New York City—4-page folder describing Stonoleum, a material for making new floors and for patching old ones.

Maintenance. Stonhard Co., 401 North Broad St., Philadelphia, Pa.—24-page book describing maintenance and repair of concrete floors with this company's products.

Metals and Alloys. Advertising Committee, U. S. Steel Corp., Frick Bldg., Pittsburgh, Pa.—48-page book illustrating and describing uses of the stainless and heat-resisting steels made by this company and its subsidiaries.

Mixers. Lancaster Iron Works, Lancaster, Pa.—Bulletin 70B—36 pages describing principles and applications of this company's complete line of Lancaster mixers.

Paints. Quigley Co., 56 West 45th St., New York City—Form C-277—6 pages on this company's triple-A, No. 44, a bituminous-base aluminum paint.

Power Equipment. Troy Engine & Machine Co., Troy, Pa.—Book listing the results of six certified surveys showing how users saved money with this company's steam engines and generating sets.

Power Transmission. Allis - Chalmers Mfg. Co., Milwaukee, Wis.—4 pages on metal sheaves for Texrope drives.

Power Transmission. Mechanical Power Engineering Associates, 684 St. Marks Ave., Brooklyn, N. Y.—39-page book giving an analysis of some fundamentals of industrial power transmission, with special reference to modern group drive.

Power Transmission. Merritt Engineering & Sales Co., Lockport, N. Y.—Form 3302—20 pages on the principle, construction and applications of the Stanley Speed Variator, an infinitely variable transmission.

Pumps. Roots-Connersville Blower Corp., Connersville, Ind. — Bulletin 60-B10 — 4 pages on this company's cycloidal rotary pumps.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—W-318-S3B—4 pages on two-stage volute centrifugal pumps.

Refrigeration. Ingersoll-Rand Co., 11 Broadway, New York City—4-page folder on steam-jet and centrifugal units for water vapor refrigeration, briefly describing properties of each type.

Valves. American Car & Foundry Co., 30 Church St., New York City—Circular 51—8 pages on an improved line of lubricated plug valves now being offered by this company.

Valves. Homestead Valve Mfg. Co., Coraopolis, Pa.—24-page booklet illustrating and describing this company's quarter-turn valves; also blow-off valves.

Welding. Haynes Stellite Co., Kokomo, Ind.—95 pages on the use of Haynes Stellite and other alloys made by this company in the hard-facing of equipment in many industries.

NEWS OF THE INDUSTRY

Proposal for tariff adjustments will find strong opposition. Code problems still under discussion. Chemical engineers arrange plant visits and student day for New York meeting. Germany considers action to restrict sale of patents abroad. New alkali plant announced for Canada. Concessions to Philippine trade may prevent imposition of import tax on coconut oil.

Plant Visits Arranged for A. I. Ch. E. Members

SEVERAL unique and unusually attractive features are planned for the semi-annual meeting of the American Institute of Chemical Engineers which will be held at the Waldorf-Astoria Hotel, in New York City, May 14, 15 and 16. Members of the Institute and their registered guests have been invited by the Standard Oil Company of New Jersey, to visit the hydrogenation plant at Bayway, N. J. A private steamer has been chartered for the trip, probably leaving and returning from the Day Line Pier, at West 42d Street. Following the banquet there will be an inspection of the radio broadcasting facilities of the new Rockefeller Center. The air conditioning plant and the unusual sound and heat insulating provisions will be of chemical engineering interest. A half-holiday with entertainment, dinner and dance at the Westchester-Biltmore Country Club in Rye, N. Y., has also been planned.

On the final day of the convention, headquarters will shift to New Brunswick, N. J., where a technical session will be held in the morning, and the afternoon will be devoted to a choice of interesting plant visits or to excursions to Princeton and other nearby points of interest.

It is expected that the details of the technical program and other arrangements will be published in the April issue of *Chem. & Met.* The general chairman of the New York meeting is Albert E. Marshall, who is assisted by Percy E. Landolt, vice-chairman, and S. D. Kirkpatrick, secretary.

Sales of German Patents May Be Restricted

IN a report from Frankfort-on-Main, Consul Sydney B. Redecker states that legislation is now being considered in Germany for placing restrictions upon the rights of German nationals to dispose of patents and inventions owned by them to foreign interests. It would appear that the proposed legislation is based somewhat upon the principle whereby German nationals are obliged to formally declare and make available to the Reich government their security and other financial holdings in foreign countries as a means of enabling the government effectively to control the foreign exchange and financial situation. A special committee has been appointed, responsible to the newly formed Foreign Trade Council to study and report upon the various proposals that have been submitted for meeting the government's desires.

If such a restrictive law is passed, it will doubtless have direct effects upon numerous American industrial concerns, especially in the chemical field, interested in exploiting German patents in the United States and elsewhere, as in addition to agreement with the owners of the patent rights, prospective buyers and exploiters will have to secure the approval of the Reich government to any proposed sale or license agreement.

Certain American industrial concerns maintain close contact with German technical progress, in some cases going even so far as to subsidize promising work in German research laboratories, with a view to securing the rights for exploiting the inventions and new processes in the United States. The possibility of utilizing this national resource in an effort to improve the country's trade situation with other countries has inspired the government to seek means of regulation so that in cases where practicable manufacturing rights will be preserved to German factories and workmen and, where sale abroad is justified, this will take place under conditions insuring the maximum benefits to Germany as a whole, as determined by the official experts of the government.

Change in Presentation of Import Statistics

WITH the publication of the January foreign trade figures the Department of Commerce inaugurates a change in import statistics advocated for some time by leading economists and statisticians. Statistics of United States import trade issued in the past by the Department of Commerce have related to "General Imports." Beginning with January 1934 import statistics will show instead "Imports for Consumption."

Import statistics as previously published under the heading of "General Imports" included two types of "import." Comprising this total were the value of goods entering the country during the period concerned and flowing immediately into the channels of trade —hitherto sometimes referred to as "imports for immediate consumption"—plus the values of those goods arriving from foreign countries for entry into bonded warehouses.

Import statistics for January and succeeding months to be referred to as "Imports for Consumption" will include goods arriving for consumption plus withdrawals from warehouses for consumption purposes. Thus the goods arriving from foreign countries for entry into warehouses will not appear in the import statistics unless and until such time as they actually are withdrawn and enter into the domestic economy of the country.

Louisiana State University Honors Dr. Coates

HIGH tribute was paid to Dr. Charles Edward Coates by Louisiana State University on Feb. 9, when the new chemical laboratory of the university was named in his honor. Dr. Coates has been head of the chemical department of the university for more than 40 years and Dean of the Audubon Sugar School since 1897. The exercises consisted of three addresses, and the unveiling of a plaque commemorating the dedication. The first address was by Dr. James Monroe Smith, president of the University, who emphasized Dr. Coates' long and faithful service and the manner in which he has built up the chemical department and the School of Applied Science. Greetings from the American Chemical Society and from Tulane University were brought by Hal W. Moseley, professor of chemistry at Tulane, and a fellow-councilor with Dr. Coates of the A.C.S. He spoke at length about Dr. Coates' attributes as a teacher and as a man and commended the university authorities for their stand in dedicating the laboratory to one who is still active on the faculty.

The dedicatory address was given by George P. Meade, manager of the Colonial Sugars Co. at Gramercy, who spoke as a representative of the cane sugar industry, which owes Dr. Coates a debt of gratitude from many viewpoints. Dr. Coates' broad knowledge of organic chemistry has made it possible for him to direct and carry out researches in analytical methods and laboratory technique; he was among the first to study the use of activated carbons for the manufacture of white sugar direct from the cane; and he has made an extensive study of the sulfitation processes so widely used in Louisiana. In connection with his work in the Audubon Sugar School Dr. Coates has kept in close touch with the manufacture of raw sugar and the rare combination of practical sugar maker and scientist has put him in a unique position in the state as a consultant.

The speaker further stated that by far the greatest contribution that Dr. Coates has made to the sugar industry has been in his work as dean of the Audubon Sugar School, which has been aptly described by the dean himself as "the first experiment in the education of chemical engineers in the United States." Graduates of the Sugar School are spread all over the cane-growing world and men have come from China, Japan, India, South Africa, Australia and the Philippines, from Europe, from the West Indies and from South America, to take advantage of this highly specialized and well-rounded course. Dr. Coates has been the dominating factor and guiding hand in the Sugar School for the past generation.

Mr. Meade pointed out that Dr. Coates was the first educator to recognize that a course in chemical engineering should take five years instead of the usual four and this plan has been followed by many of the larger universities in the United States. The Audubon Sugar School was also a pioneer in giving practical work in the field to students during the last year of the course and this practice has been copied in many universities, both in chemical and other engineering courses.

The plaque which was unveiled at the close of the ceremonies was donated by the L.S.U. chapter of Alpha Chi Sigma to whom credit is due for conceiving the idea of honoring Dr. Coates at this time and in this appropriate way.

Student Day Planned for A. I. Ch. E. Meeting

WHEN the American Institute of Chemical Engineers meets in New York, May 14-16, it is planned to provide a special program and entertainment for chemical engineering students. A committee, headed by Prof. Lincoln T. Work, of Columbia University, has organized these plans in cooperation with the Institute's Committee on Student Chapters, and the local New York Section of the Society.

The student program will begin with a luncheon at 12:45 on Tuesday, May 15, although it is expected that a number of the senior and graduate students will wish to attend the morning session of the Institute in which the papers will deal with fundamental chemical engineering subjects. Following the luncheon there will be an afternoon meeting with student papers, some discussion of chemical engineering education by members of the Institute.

The New York Local Section has offered a prize for the best student paper, and has set up certain rules to govern the competition. Those desiring to present papers should communicate promptly with Dr. Work or with the members of his committee which are as follows: Percy E. Landolt (ex-officio), chairman, New York Section; Professor Barnett F. Dodge, Yale University; Professor Joseph B. Elgin, Princeton University; Dr. Charles L. Mantell, Pratt Institute; Professor Henry Masson, New York University; Professor Herbert Moody, College of the City of New York; Professor Albert B. Newman, Cooper Union; Professor John C. Olsen, Polytechnic Institute of Brooklyn; and Dean W. T. Read, Rutgers University.

Prof. Hal W. Moseley, Professor of Chemistry, Tulane University — Dr. Charles E. Coates — George P. Meade, Manager, Colonial Sugars Co., Gramercy, La. — Dr. James Monroe Smith, President, Louisiana State University

Members of Psi Chapter of Alpha Chi Sigma who sponsored the dedication and donated the plaque

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

THE parliamentary situation rather than objections of the industries affected will prevent enactment of the food and drug bill this session. This means a repetition of the whole performance next year as Congress is hoping for an early adjournment so they can get home and prepare for November election campaigns. There is no chance of another session between now and then and the Roosevelt honeymoon Congress expires next January.

With a new edition of the Copeland bill, now S. 2800, to shoot at, the Manufacturing Chemists Association, the Synthetic Organic Chemical Manufacturers Association, the Pharmaceutical Manufacturers Association and other organizations presented numerous objections, either on brief or by personal representation at the hearings February 27-28.

The manufacturing chemists objected to the power vested in the Secretary of Agriculture to decide questions of fact pertaining to the therapeutic effects of preparations, contending that this function properly belongs to the Committee on Health that would be created by the bill. The association also protested against lack of clarity in the provision stipulating that any representation concerning any effect of a drug shall be deemed false if it is not supported by substantial medical opinion or by demonstrable scientific facts. On this, too, the association believes that the Health Committee should be the judge. The requirement that the label shall describe how palliation is affected was opposed as impractical and another requiring complete and specific directions for use was criticized because many drugs have more than one medicinal use.

Provisions regarding misbranding of germicides, bactericides, disinfectants and antiseptics were opposed because they pretend that antiseptics must be germicidal having the power of killing existing micro-organisms. This is contrary to the established meaning of the term "antiseptic" as applied to the function of inhibiting or preventing the growth of micro-organisms.

Reciprocal Tariff Plan

When President Roosevelt gave the tariff a punch he dared more in supposing that Congress would take it and like it than in springing any of the previous propositions of the new deal. Because of the rumpus that his reciprocal tariff plan will stir up, he postponed it until the administration's legislative business was well along. Even so, the fight will probably carry the session into the Summer.

The House may be whipped into line but revolt in the Senate is certain. Lacking 15 votes, the Republicans have a long way to go to defeat the bill, even though the fight is along sectional rather than party lines. They may succeed in forcing through amendments seriously circumscribing the Presidential policy but the outcome cannot be predicted.

Rate flexibility within limits of 50 per cent up or down remains, but in the President's hands it will be collapsible rather than extensible because his announced purpose is to offer inducements to foreign countries to buy American by opening markets in which to sell. No longer can a domestic industry initiate proceedings for greater protection needed to cope with new conditions. Everything is in the President's hands.

His statement that in exercising the authority sought "no sound and important American interest will be injuriously disturbed" implies that the principle applied will be the relative rights of domestic industries to be kept alive, according to the grading system contrived by the President's cabinet committee on commercial policy.

With the hearing procedure before the Tariff Commission discarded, there is no assurance that any industry will have an opportunity to defend its existence and protect its markets from being traded away. Justification for the plan depends solely on the extent that negotiations with foreign governments establish real advantages for American products abroad but domestic industries which have no export business and want no export business will oppose reciprocity under any conditions.

After three years of experimentation, chemists in the Bureau of Chemistry & Soils have succeeded in isolating and identifying the two main constituents in the natural wax of apple skins. One is ursolic acid, a high-melting, water repellant resinous acid that imparts additional hardness to lacquers. The other is impure nonacosane, a low-melting mixture of paraffin-like constituents.

American Cyanamid Co. has applied for a patent on a method of recovering the ursolic acid and Celanese Corp. of America has an application covering the use of nonacosane in lacquers to increase their impermeability.

Bureau chemists have carried their experimentation only through the laboratory stage and there is as yet no commercial work being done to recover the products. Because the products may be recovered from pomace and peels now wasted in the manufacture of cider and vinegar and in the dehydration of apples, the Bureau of Chemistry estimates that about 500,000 lb. of each material is recoverable annually.

Vegetable Oils Tax

President Roosevelt's opposition to changing the economic provisions of the Philippine independence law may also prevail upon the House Ways & Means Committee to reconsider its proposal for a tax of 5c. a lb. on imported vegetable oils. Although President Roosevelt's recent message to Congress did not refer to the tax bill, his assertion that changing economic provisions in the reenactment of the independence law would reflect discredit on the United States leaves no doubt as to his attitude regarding the House Committee's proposal, the effect of which would be to shut out imports of oils from the Philippines. Industrial consumers previously had not been able to influence the committee, playing into the hands of the farm lobby.

Rayon knitters jumped the rayon producers for price-fixing and now the knitters are threatened with mandamus proceedings by the Underwear Institute to force them under the code of the knit underwear and allied products industry. The rayon knitters object to domination by the Institute and demand a separate code. Numerous complaints against the competition of rayon products have been registered with the Institute by producers operating under the code.

NRA refused to act on the complaint of the Texas Mining & Smelting Company, of Laredo, that imports of Chinese antimony warrant restriction as provided by the Recovery Act, as such competition is endangering maintenance of the PRA under which the company is operating pending approval of its code. General Johnson held that examination of the complaint showed that the facts do not warrant further investigation on his part.

The cost accounting formula for fertilizer industry has been approved by Gen. Johnson pursuant to the application of the industry's recovery committee and was scheduled to become effective March 10.

Hearing on the tank car service industry's code developed that the sponsors desire to exclude from its application products whose transportation is subject to ICC specifications with reference to explosives and other dangerous articles. This meets the objections of the Manufacturing Chemists' Association, which takes the position

that while chemical companies own a small proportion of the privately owned tank-cars, they are not in the tank car service business. To be released soon is the report of W. P. Bartel, chief of the Bureau of Service of the Interstate Commerce Commission on his investigation into the private freight car situation. This will deal with allowances made by the railroads to the owners of such equipment. Pending the ICC's consideration of the Bartel report no action will be taken on the railroads' proposal for a reduction in such allowances.

Competition of government with private industry continues to disturb National Association of Manufacturers, and many private concerns. This association through its special Manufacturers Committee on government competition, has been urging in Washington attention for H.R. 6038 which is a bill intended to provide a standard system of cost-keeping for the executive departments of the Government. The argument is, in essence, if the Government is going to compete, then they might at least use a fair system of accounts disclosing not only direct labor and materials costs, but also depreciation and other capital cost items.

A bill has been introduced in the House which would have for its purpose the prohibition of imports of pulpwood, wood pulp, or any wood susceptible of use in manufacturing paper.

Proposals also are being made to amend the sugar bill so as to restrict imports of blackstrap molasses into this country. Quota restrictions for such importations are asked on the ground that this material is cutting down the amount of corn and other grains in the manufacture of alcohol.

As the three day conference of code authorities did not succeed in ironing out all the difficulties and especially was not promising from the standpoint of introducing a shorter hour working week, it was followed by conferences held between General Johnson and industry group representatives.

Headed by George Houston, president, Baldwin Locomotive Works, the capital goods committee met with Administrator Johnson on March 8 and offered many suggestions. They pointed out that workers in the industry now were working fewer than 35 hours a week and said that a proposed 10 per cent reduction from the present 40-hour week would not result in the employment of more men. The committee voiced criticism of provisions now embodied in the Securities Act and held that as a result credit which was very necessary for the expansion of these industries was withheld and they stressed the importance of some action which would open up credit to industry.

Henry Wise Wood, president of the Wood Newspaper Machinery Corporation, New York, in response to Johnson's request for useful suggestions, proposed that during the emergency all corporation earnings which are reinvested in capital goods should be exempt from Federal taxation.

He said this would stimulate replacement of obsolete equipment, promoting employment and eventually increasing earning power.

A committee of the consumers' goods industry conferred at length with Johnson and agreed to form a permanent organization to work with the Administration on recovery problems.

Criticism of the Securities Act and the proposed stock market control bill now pending in Congress also came from the business advisory council for the Department of Commerce, headed by Gerard Swope, who said industry agreed with the purpose of the two measures but disagreed with several drastic provisions included.

The council indorsed an Administration plan which would make it impossible for small industrial borrowers to finance their requirements at local banks through Federal Reserve bank assistance.

"The small manufacturer or distributor, who has needs for lesser sums (than a million dollars) either for permanent capital or for purposes that will permit of repayment within a few years, finds no facilities to meet these needs," the resolution said.

Filtrol Plant Planned for Mid-Continent Section

PROMPTED by an increasing demand for Filtrol from both American and foreign sources, Filtrol Co. of California has announced its plans for the construction of a new plant to be located in the Mid-Continent area. According to Lester L. Robinson, chairman of the board, and G. Howard Hutchins, president of the Filtrol organization, the exact site of the new plant has not been definitely determined yet, although there are three under consideration. Plans and specifications for the plant, which will have a larger capacity than the present California setup, are nearing completion. Bids on equipment and material will be called for in the near future.

Messrs. Robinson and Hutchins, in speaking of this contemplated expansion program, said: "The increasing demand for various brands of Filtrol not only in the Mid-Continent area, but on the Atlantic Seaboard, has necessitated this move on our part. The source of supply for the raw material from which Filtrol is manufactured is such that it will readily lend itself to delivery in the Mid-Continent section."

Delaware Rayon Co. Denies Price Fixing Complaint

THE Delaware Rayon Co., Newcastle, Del., has filed an answer with the Federal Trade Commission in which it denies the charges of price fixing made by the commission at the beginning of February.

The complaint of the commission alleges that in October, 1931, the ten companies entered into "an agreement, combination, understanding and conspiracy among themselves" to eliminate price competition among themselves, it being added that they "have since carried out and are still carrying out" this agreement to fix and maintain uniform prices of viscose rayon yarn entering interstate commerce. In carrying out the agreement, the commission charged, these companies have curtailed and limited their production of viscose rayon yarn, thus limiting the supply of that yarn and of rayon cloth and rayon wearing apparel sold in interstate commerce.

Three other companies, the Viscose Co., du Pont Rayon Co. and Industrial Rayon Corporation, all of New York, have been granted extensions of time to file answers. Their requests for additional time to gather the desired information sought permission to defer filing until May 1, but the commission limited the extension to March 31.

The Delaware company told the commission that it has conducted its business in strict accordance with law; that it "has not directly or indirectly entered into any agreement, or made any understanding of any kind with any other corporation, firm or concern for the purpose of securing monopoly, or for the purpose of regulating the price of rayon yarn, rayon cloth, rayon garments or other rayon articles of wear."

Control Committee for Naval Stores

MEMBERS of the naval stores industry, by ballot, have selected the men who will comprise the Control Committee which will set up quotas and otherwise direct the industry according to the marketing agreement with the Secretary of Agriculture.

Members of the committee for the several producing states are: North Carolina and South Carolina—W. L. Rhodes, Estill, S. C. Georgia—W. B. Gillican, Homerville; G. W. Varn, Valdosta; W. O. Wingate, Ocilla. Florida—R. L. Black, Gainesville; A. F. Bullard, DeFuniak Springs; E. A. McCloskey, Lake City. Alabama—M. C. Stallworth, Mobile.

Southwestern Territory—R. M. Newton, Wiggins, Miss.

Monsanto Subsidiary Will Make Petroleum Resins

A NEW company, Monsanto Petroleum Chemicals, Inc., a controlled affiliate of Monsanto Chemical Co., has been organized with headquarters in Dayton, Ohio. The new company will take over the plant and processes of the Dayton Synthetic Chemicals, Inc., which was formed about four years ago as a subsidiary of the Thomas & Hochwalt Laboratories, Inc., to exploit the manufacture and use of petroleum resins.

Edgar M. Queeny, president of Monsanto Chemical Co., is president of the new company with Charles A. Thomas vice-president and general manager. The research work will continue to be performed in the laboratories of Thomas & Hockwalt.

Stockholders of the Monsanto Chemical Co. will vote at their annual meeting on a proposal to capitalize $4,320,000 of the paid-in surplus of the company and to distribute the additional common stock to present stockholders at the rate of one new share for each share now held.

The company has notified the New York Stock Exchange of its intention of increasing the authorized common stock from 500,000 shares to 1,250,000 shares. It is the intention of the management to pay dividends on the increased capitalization at the rate of 25c a share quarterly, equal to $2 per share annually on the present capitalization, which now receives $1.25 per share annually.

Fertilizer Interests Fear TVA Activities

THERE are strong indications that the Tennessee Valley Authority is moving rapidly in the direction of large scale fertilizer production, according to Charles J. Brand, executive secretary and treasurer of The National Fertilizer Association, in a recent interview. "Already $4,000,000 have been allocated to the fertilizer project, and it seems safe to conclude that the Authority is considering the manufacture of fertilizer on a commercial scale in competition with the existing industry, which is now operating at only slightly more than a quarter of its capacity." Mr. Brand pointed out that in the nine States that are located in or near the Tennessee Valley there are 463 fertilizer plants with a capacity to produce fully 8,400,000 tons of mixed fertilizer annually. In the same group of States the peak consumption reached in 1930 amounted to only 4,740,000 tons of all fertilizer and in 1932 consumption dropped to 2,222,000 tons or to only 22 per cent of capacity.

"The Act that created the Authority is mandatory with respect to the experimental fertilizer program, but no large scale production of fertilizer by the Government is required," Mr. Brand said.

Germany Bans Erection of New Nitrogen Plants

THE recently reconstructed German nitrogen cartel was endangered when one of its members, the Gewerkschaft Ewald, served notice of termination of its membership in the cartel as from June 30, 1935. This company contemplated a substantial expansion of its plant regardless of the large excess capacity already existing in the German nitrogen industry, which is now operating approximately at 35 per cent of its capacity.

George R. Canty, trade commissioner at Berlin reports that in order to prevent what the present Government considered a malinvestment of capital, the Federal Minister of Economics, has, in virtue of the cartel law of July 15, 1933, which was published on Jan. 26, 1934, prohibited the erection of new nitrogen plants in Germany. It was stated that Ewald had let contracts for a third unit to cost 4 or 5 million marks for completion July 1, 1935 with a capacity of 23,000 tons nitrogen. The existing two units, which have a capacity of 22,500 tons N, cost 20 million marks. Low average unit costs were envisaged with the completion of the new plant which was designed to incorporate the latest technological improvements.

This prohibition will be effective until June 30, 1940, to which date the nitrogen cartel, which now controls 100 per cent of the German production, has been prolonged. The prohibition applies to the production of synthetic ammonia and to calcium cyanamide. It is forbidden to erect new plants for the manufacture of these products or to increase the capacity of existing plants.

Fertilizer Tag Sales Gain In February

FERTILIZER tag sales in the cotton belt during February were above sales in the corresponding month last year and two years ago but somewhat smaller than in February three years ago, according to the New York Cotton Exchange Service. The quantity of fertilizer represented by fertilizer tag sales in the nine principal cotton-growing States during February totaled 418,000 short tons, as compared with 210,000 in the corresponding month last year, 252,000 two years ago, and 460,000 three years ago.

Ceramic Society Meets In Cincinnati

ASSEMBLING in Cincinnati during the week of Feb. 11, some 700 delegates made the 37th annual meeting of the American Ceramic Society one of the most productive yet held by the organization. An outstanding feature was a symposium on heat transfer and heat losses in industrial furnaces.

Officers elected by the society included the following: W. K. McAfee, Universal Sanitary Mfg. Co., president; J. M. McKinley, North American Refractories Co., vice-president; H. B. Henderson, Standard Pyrometric Cone Co., treasurer; and R. C. Purdy, secretary. C. W. Parmelee, of the University of Illinois, was elected dean of Fellows.

Swift Forms Subsidiary for Fertilizer Business

A NEW subsidiary of Swift & Co. has been formed to handle the fertilizer business of the company. G. F. Swift, president of Swift & Co., issued the following announcement: "As the fertilizer business of Swift & Co., both from a manufacturing and distribution standpoint, has always been handled as a separate unit, it has been thought desirable to create a separate corporation for the business, namely, 'Swift & Company Fertilizer Works', with headquarters at Chicago."

New Caustic Soda Plant For Canada

ANNOUNCEMENT has been made in Canada that Canadian Industries, Ltd. which is the only producer of caustic soda in Canada, will increase its output of this chemical through the erection of a new plant for caustic soda and chlorine. The new plant will be located at Cornwall, Ont., and will cost $900,000 with an additional outlay of $300,000 for auxiliary equipment.

Federal Chemical Buys Fertilizer Plant

AN announcement from Wood Crady, vice-president of Federal Chemical Co., states that his company has purchased the fertilizer factory, trade name, and good will of Meridian Fertilizer Factory at Shreveport, and the fertilizer factory, sulphuric acid chambers, and equipment at Meridian, Miss. The Hattiesburg plant of Meridian Fertilizer Factory was not included.

Sulphur Production Gained 58 Per Cent Last Year

IN A preliminary report the Bureau of Mines states that production, shipments, and exports of sulphur in 1933 showed large increases in comparison with 1932. Production was 58 per cent, shipments 48 per cent, and exports 48 per cent higher in 1933 than in 1932, but they were 29 per cent, 9 per cent, and 10 per cent, respectively, below the averages for the 5-year period 1928-1932. Shipments exceeded production; consequently, stocks at the mines were reduced. Production of sulphur was reported from California, Louisiana, Texas, and Utah.

Sulphur output amounted to 1,406,063 long tons in 1933, a gain of 58 per cent, compared with the output in 1932 of 890,440 tons. Shipments increased from 1,108,852 tons, valued at about $20,000,000 in 1932, to 1,637,368 tons, valued at about $29,500,000 in 1933, or 48 per cent in both quantity and value. Stocks at the mines on Dec. 31, 1933, had decreased to 2,799,950 tons, or 231,310 tons below the reserve at the close of the preceding year.

The new property of the Freeport Sulphur Co., in Plaquemines Parish, La., was put into operation during the year. A production of 17,705 long tons was reported by this company but no shipments were made. The Jefferson Lake Oil Co., Inc., in Iberia Parish, La., increased its production from 13,401 tons in 1932, to 303,787 tons in 1933. No shipments were made in 1932 but in 1933, 128,916 tons were shipped.

Texas produced 1,083,445 tons of sulphur in 1933, or 77 per cent of the country's total. In 1932 Texas produced 98 per cent of the country's total, or 876,294 tons. The properties that contributed to the production in 1933 were those of the Duval Texas Sulphur Co. at Palangana Dome, Benavides; Freeport Sulphur Co. at Bryan and Hoskins Mounds, Freeport; and the Texas Gulf Sulphur Co. at Long Point Dome, Long Point, and at Boling Dome, Newgulf.

The production of sulphur in California and Utah amounted to 1,126 long tons in 1933. The Bureau of Mines is not at liberty to publish these figures separately.

Imports of sulphur ore amounting to 4,773 long tons were recorded by the Bureau of Foreign and Domestic Commerce in 1933. This is the first time that sulphur has been imported into the United States since 1930, at which time 29 tons of "sulphur and sulphur ore" were recorded.

Exports of sulphur in 1933 totaled 522,515 long tons, compared with 352,610 tons in 1932, an increase of 48 per cent. Exports to all the countries that receive important quantities, with the exception of those to Australia and New Zealand, showed increases. Australia and New Zealand received much larger quantities in 1932 than in 1931, while the other important consuming countries showed large decreases. Canada received 122,954 tons in 1933, compared with 95,800 tons in 1932; France, 84,093 tons, compared with 60,591 tons; Germany, 69,139 tons, compared with 31,275 tons; United Kingdom, 47,149 tons, compared with 18,129 tons; Australia, 37,726 tons, compared with 60,809 tons; Netherlands, 27,449 tons, compared with 13,959 tons; New Zealand, 26,446 tons, compared with 33,654 tons. Shipments to the United Kingdom in 1933 were the largest ever recorded. Exports of crushed, ground, refined, sublimed and flowers of sulphur in 1933 were 19,629,405 lb., an increase over the 16,285,095 lb. exported in 1932. The principal importing countries were Canada with 5,161,960 lb.; Australia, 2,316,670 lb.; Germany, 2,016,392 lb.; United Kingdom, 1,452,058 lb.; Mexico, 1,153,116 lb.; and Uruguay, 1,013,600 lb.

Larger Pyrites Output

Production of pyrites in the United States during 1933 amounted to 274,476 long tons, valued at $755,420. This compares with 186,485 tons, valued at $492,043, in 1932, and 330,848 tons, valued at $974,820, in 1931.

Virginia was the largest producing State in 1933. Other states that produced pyrites in 1933 were California, Colorado, Missouri, New York, Tennessee, and Wisconsin.

Missouri increased its output from 3,958 long tons in 1932 to 18,355 tons in 1933. The production in 1932 was from one mine, whereas that in 1933 was from four properties. The output in Missouri in 1932 was the first tonnage reported since 1920. A production of 19,824 long tons of pyrites concentrates in New York was recorded for 1933. This is an increase of 2,953 tons over the production reported in 1932. Colorado shipped 4,059 long tons in 1933 from mill-tailings dump of the Colorado Zinc Lead mill, in Lake County. In 1932, 1,496 tons was shipped from this property.

In 1933 the quantity of pyrites sold or consumed by producing companies totaled 272,748 tons, a gain of 47 per cent, compared with 185,654 tons in 1932. The amount sold or consumed in 1931 was 330,145 tons. The pyrites produced in 1933 contained approximately 102,969 long tons of sulphur; in 1932 the output contained about 64,826 tons of sulphur, and in 1931, 121,503 tons.

Imports of pyrites in 1933 were 374,417 long tons, compared with 253,248 tons imported in 1932. Of the quantity imported in 1933, Spain furnished 341,878 tons, Canada, 29,970 tons, and Soviet Russia, 2,569 tons.

Potash Mineral Found In Kansas

THE U. S. Geological Survey has announced the discovery and identification of the potash mineral polyhalite in a sample of well cuttings from western Kansas. This is the first recognition of this mineral in that state. F. C. Calkins and R. K. Bailey, of the Geological Survey staff found it in cuttings submitted by the Central Commercial Oil Co. from a well in Trego County, about 4 miles south of Riga, from a depth of about 2,000 feet, which in that locality is approximately sea level. The polyhalite made up only about 5 per cent of the sample and hence has no commercial interest in itself. Nevertheless the locality is in a part of the great Permian salt basin that has not hitherto yielded definite showings of potash, the known occurrences being farther south in New Mexico and Texas. Thus this identification suggests that further exploration in Kansas might lead to the discovery of richer bodies of potash salts of possible commercial value. It should be remembered that the finding and identification of polyhalite in cuttings from an oil well in Texas was the first step leading to the development of the present potash industry in New Mexico. Salt deposits have long been known in eastern Kansas, but the salt is practically free of potash. Very small percentages of potassium, however, have been reported in some mineral waters of the state.

Sulphur Price Guaranteed To Italian Producers

A REPORT from Elizabeth Humes, trade commissioner at Rome, states that an Italian decree authorizes the Sulphur Sales Office to guarantee sulphur producers the following minimum prices: Grade: Superior yellow 267 Lire per ton, Inferior yellow 257 Lire per ton, Good 249 Lire per ton, Ordinary (corrente) 241 Lire per ton.

These sales prices cover all stocks of sulphur held by producers on Dec. 11, 1933, and on all sulphur produced between that date and July 31, 1934. It is stated that on the above guaranteed minimums, the Sulphur Sales Office must take a loss of from Lire 80 to Lire 100 per ton on exports of crude sulphur.

Present stocks of sulphur estimated at about 110,000 tons, and this stock as well as the new production up to next August must be disposed of. In recent months, Italian sulphur has lost a large part of the crude sulphur export markets and, therefore, special efforts will be made to hold the markets for refined sulphur.

NAMES IN THE NEWS

A. L. Taylor has joined the Pease Laboratories, New York, where he is director of the chemical department. Dr. Taylor in recent years has been co-operating with the U. S. Bureau of Standards in the development of new uses for xylose. Previously he had been associated with the research staff of E. R. Squibb & Sons, and Sirdler Corp.

Rowland J. Clark has been made chief chemist for the Mueller Bakeries, Grand Rapids, Mich. Mr. Clark has been studying the problems related to the use of dry skim milk in cakes for the American Dry Milk Institute.

A. R. Alger has recently become associated with the Peters Iron Works, Inc., Perth Amboy, N. J., as chief engineer. Mr. Alger was formerly with the Semet Solvay Engineering Corp.

Clifton V. Berry, formerly with the Harris Drug Co., is now connected with the York Chemical Co., New York.

Harold Crooks has joined the chemical department of the Petroline Laboratories, Inc., New York. Mr. Crooks came to New York from Toronto, Canada, where he was connected with the Shuttleworth Chemical Co. and the Associated Chemical Co.

John P. Dunne, formerly with the Durium Products, Inc., of New York, is now in the chemical research department of the American Hard Rubber Co.

Hugh B. Gordon is a research chemist with the Julius Kayser & Co., New York. Dr. Gordon was until recently professor of chemistry at the Alabama Polytechnic Institute, Auburn, Ala.

John Sparrow, formerly with Bachmeier & Co., is now located in New York with the Nova Chemical Corp. Mr. Sparrow is in the chemical laboratory of the Nova organization.

Thomas S. Taylor has joined the Boston Blacking & Chemical Co. Until recently Dr. Taylor had been chief research physicist for the Bakelite Corp. at Bloomfield, N. J.

W. W. Purdy of Camden, N. J., has recently returned from several months work in Mexico.

Clark C. Heritage

Clark C. Heritage, manager of the Maine Coated Division of the Oxford Paper Co., has been elected president of the Technical Association of the Pulp and Paper Industry. Mr. Heritage's connection with the paper industry extends back to 1914. For several years he was senior chemical engineer in charge of pulp and paper at the Forest Products Laboratory, Madison, Wis., but resigned in 1929 to join the Oxford organization.

Grellet N. Collins of the International Paper Co., has been elected vice-president and R. G. MacDonald re-elected secretary of T.A.P.P.I.

Robert L. Stewart is in Connecticut where he is located as a research chemist with Edwin Larsen. Previously he had been in the chemical departments of the Southwestern Portland Cement Co., the Western Electric Co. and the General Chemical Co.

Louis N. Markwood, formerly with the U. S. Tariff Commission, is now with the Department of Agriculture in Washington, D. C.

J. Tenney Mason, after serving 18 years with E. I. duPont de Nemours & Co., has become associated with the U. S. Industrial Alcohol Co. as assistant to Charles S. Munson, president. All of the company's activities in the molasses business will be under the supervision of Mr. Mason.

Morris E. Leeds, president of Leeds & Northrup Co., has assumed vice-chairmanship of the Industrial Advisory Board of N.R.A.

Chaplin Tyler has been appointed manager of sales development of the ammonia department of E. I. duPont de Nemours & Co. Dr. J. F. T. Berliner, who is associated with Mr. Tyler, was also transferred from the chemical to the sales division.

Everett Chapman, who joined Lukenweld, Inc., division of Lukens Steel Co., early in 1930 as director of engineering and research, has been elected vice-president.

George Barsky and Ernest D. Wilson have formed the consulting firm of Barsky and Wilson with offices at 521 Fifth Ave., New York.

George Reid has become editor of *Refiner and Natural Gasoline Manufacturer* succeeding Grady Triplett. Mr. Reid, a graduate of the University of Arkansas, has had various experience with refineries in Louisiana, Arkansas and Texas before joining the staff of the *Refiner* in 1926.

Harold C. Urey of Columbia University has been awarded the Willard Gibbs medal by the Chicago Section of the A.C.S.

Robert P. Fischelis has been elected president of the American Pharmaceutical Association.

S. R. Church, consulting engineer of New York, has been elected president of of the American Wood-Preservers' Association.

Edward W. Washburn has been awarded post-humously the Hillebrand prize by the Chemical Society of Washington.

CALENDAR

American Institute of Chemical Engineers, spring meeting, New York City, week of May 14.

American Chemical Society, spring meeting, St. Petersburg, Fla., week of March 25.

Electrochemical Society, and American Ceramic Society, joint meeting, Asheville, N. C., April 26-28.

American Petroleum Institute, mid-year meeting, Pittsburgh, Pa., May 22-24.

American Society for Testing Materials, annual meeting, Atlantic City, June 25-29.

Technical Association of the Pulp and Paper Industry, fall meeting, Portland, Ore., Sept. 10-13.

William L. Heald, chief chemist for the Omaha Flour Mills Co., has assumed charge of the laboratory and production control department of Flour Mills of America.

Marion D. Coulter is employed on the Toledo Precision Devices' fellowship at Mellon Institute. He will investigate problems involved in food merchandising.

Arthur L. Davis, recently a member of the research staff of Vacuum Oil Co., is now a member of the chemical engineering division of the Tennessee Valley Authority, with headquarters at Knoxville.

George H. Mead, president of Mead Paper Co., has been appointed to be an administration member of the Chemical Industry Code Authority.

C. W. Crowell has been elected vice-president in charge of production of both the Rochester Germicide Co. and the Canadian Germicide Co. His headquarters are in Rochester. For several years Mr. Crowell, who is a Stanford graduate, was a chemical engineer for Southern Glass Co., Los Angeles.

Lammot du Pont, president of E. I. du Pont de Nemours & Co., and Dr. Frank B. Jewett, president of the Bell Telephone Laboratories and vice-president of the American Telephone and Telegraph Co., have been elected to life membership in the corporation of the Massachusetts Institute of Technology. Both men have studied at M.I.T. and both were formerly term members of the corporation.

Harry L. Gilchrist, retired chief of the Chemical Warfare Service, has been named as the Government Code Authority of the lumber and timber products industry.

Major-General Gilchrist had been appointed chief of the Chemical Warfare Service early in 1929 after having served this branch of the national defense for ten years. He was prominent in its pioneer organization and participated in nine of the different engagements in which the Chemical Warfare took part.

Pierre S. du Pont has retired as chairman of the Industrial Advisory Board of the National Recovery Administration. The new chairman is Henry S. Dennison, president of the Dennison Manufacturing Co., Framingham, Mass.

Edward Bartow, head of the department of chemistry and chemical engineering at the University of Iowa is chairman of the delegation appointed to the Ninth International Congress of Pure and Applied Chemistry which is to convene at Madrid on Apr. 5, 1934.

Philip Byrnes of the general engineering department of the Standard Oil Development Co. has been transferred to Aruba, Venezuela, where he will be in charge of the technical service department.

J. B. Garner of the Anglo-American Oil Corp. of London is visiting in New York.

David Sheppard of the Lubrication Engineering Division of the Standard Oil Co. of N. J. has been transferred to similar work in London.

R. M. Gage has resigned his position in laboratory and process engineering work with the Fisk Rubber Co., Chicopee Falls, Mass., and has joined the Mansfield Tire & Rubber Co., Mansfield, Ohio.

OBITUARY

W. D. Mount

W. D. Mount, consulting chemical engineer of Lynchburg, Va., died suddenly at his home on February 28 at the age of 67. Mr. Mount was born in Groton, N. Y., and attended Cornell University. For 20 years previous to 1918 he was successively general superintendent, general manager and director of the Saltville, Va., plant of the Mathieson Alkali Works. Since that time he had carried on an extensive consulting practice in the fields of lime, alkali and paper manufacture.

He was the holder of numerous patents in these fields, among which the most notable are for continuous, gas-fired, vertical lime kilns; continuous rotary filters of the vacuum and pressure types; and continuous caustization with lime recovery.

William R. Cathcart of Leonia, N. J., was visiting in Asheville, N. C., when he was stricken ill on February 20 and died two days later. He was 65 years old. Dr. Cathcart was technical director of the Corn Products Refining Co., with which he had been associated for 18 years.

Dr. Cathcart was born in 1869. He attended South Carolina College and later Heidelberg University. From the latter he received his doctor's degree in chemistry, physics and mineralogy in 1892. When he returned to this country the following year he was placed in charge of the laboratory of the Grasselli Chemical Co. A year later he joined the faculty of the College of Charleston as professor of chemistry. In 1898 he resigned this position to accept the appointment of chief chemist of the Schaefer Alkaloid Works & Standard Essence Co. And from 1913 to 1916 Dr. Cathcart was associated with F. G. Falding.

James M. Bell, dean of the school of applied science in the University of North Carolina and a member of the faculty for 24 years, died of a heart attack March 3 at Clearwater, Fla. He had gone to Florida in an effort to regain his health. Dr. Bell was 53 years old.

Chesley, Ontario, was the birthplace of Dr. Bell. He attended Toronto and Cornell Universities. From the latter he received the Ph.D. degree in 1905. On graduating from Cornell he entered the U.S. Department of Agriculture and remained with the bureau for five years. He then became associate professor of physical chemistry at the University of North Carolina. In 1921 he became head of the department and in 1929 dean.

Frank W. Kennedy, vice-president and general manager of the DeLaval Steam Turbine Co., died at his home at Yardley, Pa., January 24 after a short illness.

Mr. Kennedy was born at Pittsburgh, Pa., in 1876, and attended the Shadyside Academy of that city. He graduated from Princeton University with the degree of Civil Engineer in 1898, and thereafter occupied positions successively with the Pennsylvania Railroad at Altoona, the U. S. Steel Corporation at one of the Ohio subsidiaries, and the Dravo-Doyle Co., Pittsburgh. In 1908 he became general manager of the De Laval Steam Turbine Co. at Trenton, and in 1916 was elected vice-president. He was a director of that company and also president and director of the American Bauer-Wach Corporation, with offices in New York.

George S. Brush, president of the Brush Pottery Co., died at his home in Zanesville, Ohio, February 25, after a week's illness. He was 63 years old.

Oliver J. Bond, formerly assistant commandant of the Chemical Warfare School at Edgewood Arsenal, died of pneumonia February 28 at Columbus, Ohio. Major Bond was 43 years old.

CHEMICAL ECONOMICS

Production of chemicals gained slightly more than 3 per cent in January as compared with the preceding month and the operating rate in February was about the same as in January. Some of the large consuming industries have been speeded up to a still greater extent and apparently have reduced consumer stocks of raw materials.

WITH THE principal consuming industries taking up larger supplies of raw materials, the output of chemicals has continued on an upward trend. According to consumption of electrical power, production of chemicals increased a little more than 3 per cent in January over the rate maintained in December. The index of production in January is 133.1 which compares with 115.5 for January, 1933. While reports for operations in February are not yet complete, the data already available would indicate that chemical production for the year to date was running approximately 18 per cent ahead of that for the corresponding period of last year.

The trend of production from January to April last year was downward and if current outputs are maintained or improved upon the comparison of the first four months of this year and the like period of 1933 will be highly favorable.

The improvement in the automotive trade is especially noteworthy in view of reports that production schedules were advanced in February and still further extended in March although labor troubles were experienced and are threatening to become more widespread. Estimated production of steel ingots for the first two months of this year placed the total at 4,221,595 tons which compares with 2,116,942 tons for the corresponding period of 1933 or a gain of close to 100 per cent.

Consumption of crude rubber by manufacturers in the United States for the month of January amounted to 40,413 long tons, which compares with 29,087 long tons for December and represents an increase of 38.9 per cent over December and 76.4 per cent over January a year ago, according to statistics released by the Rubber Manufacturers Association. Consumption for January, 1933 was reported to be 22,906 long tons.

In the accompanying table will be found the latest available figures for production and consumption in leading chemical-consuming industries. The percentages of change from December and from January, 1933, show that in practically all cases the new year started off at a higher rate than was reached in the closing month of last year and remarkable gains were recorded as compared with January, 1933.

Plastics show up prominently in this comparison with cellulose-acetate products showing a larger proportionate increase than the nitrocellulose products. The rise in steel operations naturally finds a parallel in the case of byproduct coke production. Sales of explosives are swinging upward and glass makers share in the general business uplift.

Rayon production has been holding up and stocks in producers possession are reported to be unusually low. All branches of the textile industry have been moving forward with silk, which had been lagging, now reported to be gaining ground.

Soap makers have found a wide outlet for their products and in some cases stocks have been drawn upon to make deliveries. The fear that an import tax will be placed on imports of coconut oil is said to have influenced soap distributors to stock up more heavily than usual.

The increase in demand for paint and varnish-making materials in the latter part of last year is reflected in the movement of China wood oil to this country. Total shipments from Hankow to American ports in 1933 amounted to 146,022,000 lb. in comparison with a total of 106,780,460 lb. shipped in 1932. The 1933 shipments were the largest on record.

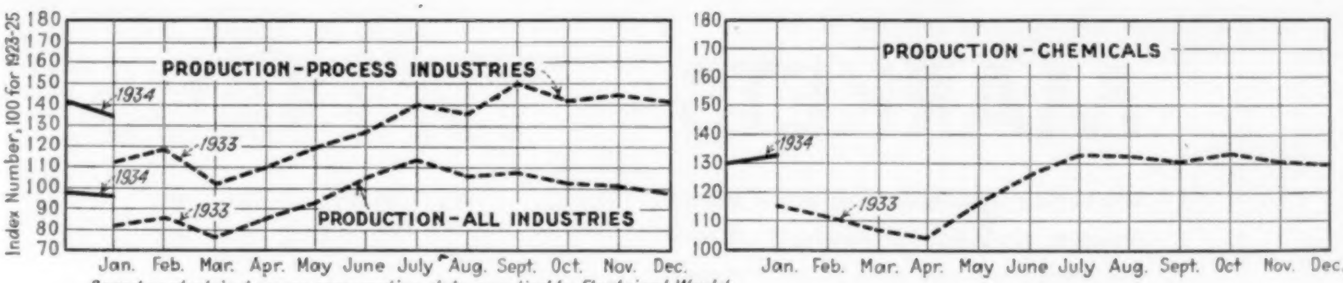
Production of rubber tires in January is reported to have shown a gain of 30 per cent over the December total and the February output is said to have more than doubled that of February, 1933.

The textile and rayon industries have reported more than seasonal increases for the year to date. Deliveries of silk to mills in February amounted to 39,021 which represented a decline of 1,921 bales from the January total but was 6,356 bales above the amount delivered in February, 1933.

Production and Consumption Data for Chemical-Consuming Industries

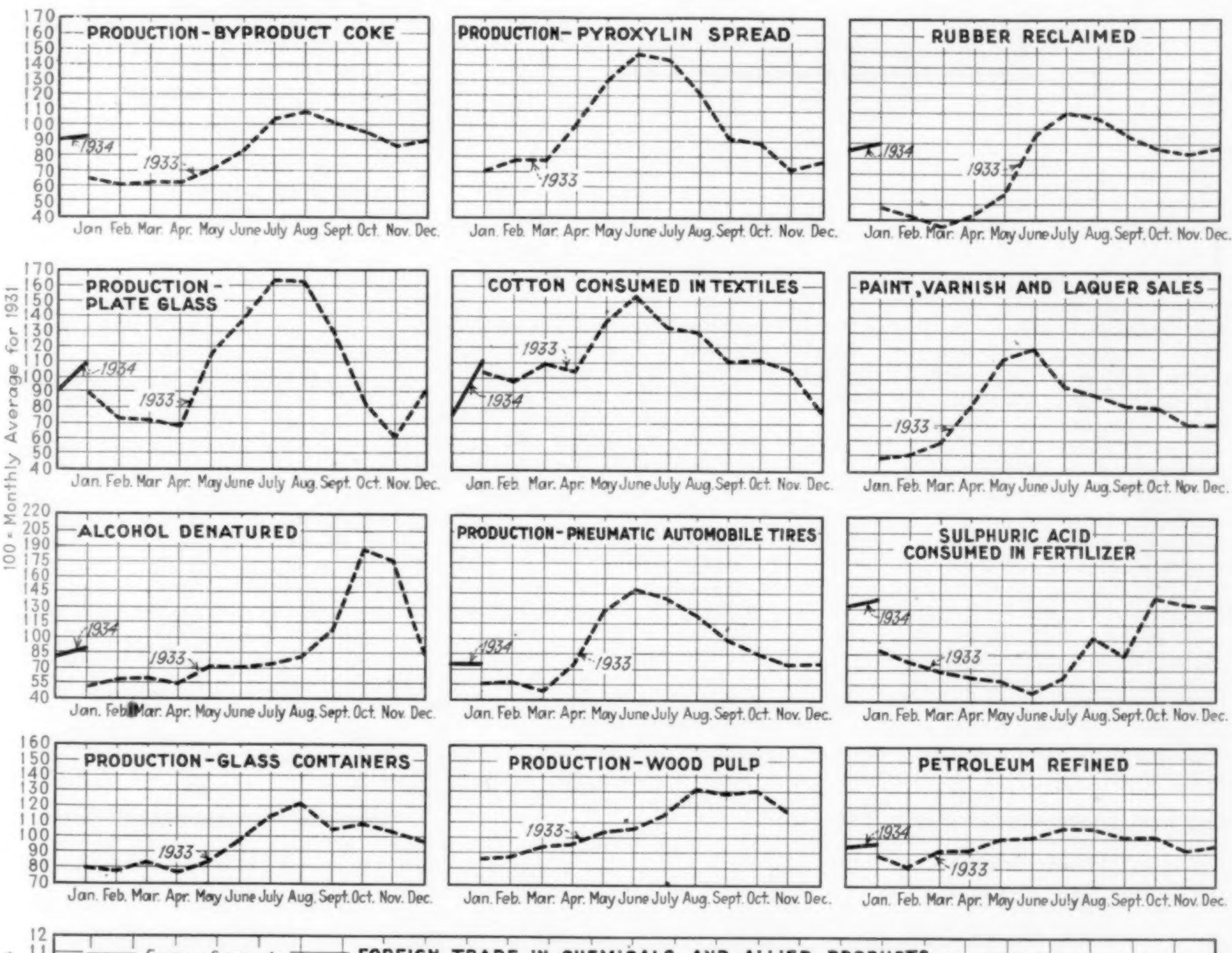
Production	Jan. 1934	Jan. 1933	Dec. 1933	Per Cent of gain Jan. 1934 over Jan. 1933	Per Cent of gain Jan. 1934 over Dec. 1933
Automobiles, No.	161,006	130,087	84,152	23.7	91.3
Byproduct coke, 1,000 tons	2,476	1,785	2,455	38.7	....
Cottonseed oil, crude, 1,000 lb.	145,587	135,610	137,987	7.3	5.5
Cottonseed oil, refined, 1,000 lb.	110,950	112,929	122,426	1.7*	9.4*
Cellulose-acetate plastics					
Sheets, rods, tubes, No.	357,836	167,856	325,412	113.2	9.9
Nitro-cellulose plastics					
Sheets, rods, tubes, No.	947,781	592,497	797,897	59.9	18.7
Explosives, 1,000 lb.	28,504	17,971	23,318	58.6	22.2
Plate glass, 1,000 sq. ft.	7,607	6,188	6,347	22.9	20.3
Sulphuric acid produced in fertilizer trade, tons	143,811	114,618	155,695	25.4	7.6*
Steel barrels, No.	662,293	292,201	556,586	126.6	19.0
Rosin wood, bbl.	46,850	31,118	40,433	50.5	15.8
Turpentine, wood, bbl.	7,970	4,975	6,916	60.2	15.2
Rubber reclaimed, tons	9,238	4,983	8,966	85.3	3.0
Petroleum refined, 1,000 bbl.	71,512	66,093	70,440	8.2	1.5
Consumption					
Cotton, 1,000 bales	508	470	348	8.1	46.0
Silk, bales	40,942	46,204	26,959	11.4*	51.8
Sulphuric acid in fertilizer trade, tons	158,973	101,336	150,097	56.8	5.9

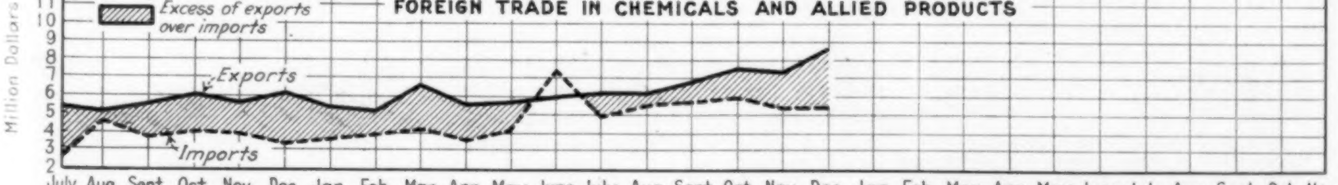
*Per cent of decline



Based on electrical power consumption, data supplied by Electrical World

TRENDS OF PRODUCTION AND CONSUMPTION





MARKETS

Marketing agreement for naval stores industry provides for payment of fees for processing and marketing. France reported to have placed order for American nitrate of soda. Permit terminated under which unlimited sale of alcohol made from molasses was permitted. Prices for chemicals hold firm with the trend still upward.

FAVORABLE reports regarding activities in important consuming industries bear out the statement deliveries of chemicals are going forward in large volume. As usual contract withdrawals account for the greater part of the movement but spot trading in some selections has been more active of late with the textile, dry color, rubber, and plating trades prominent on the buying side.

Producers of salt cake find difficulty in finding a market for their product. For some time, European producers, with salt cake on the Free List, have been able to obtain contracts from large domestic consumers by quoting delivered prices which placed the home product at a disadvantage. More recently, salt cake from Chile has entered as a market factor and some domestic producers have been forced to discontinue manufacture of salt cake. Some large buyers have given the preference to foreign material because they feared the inability of domestic producers to make regular deliveries. In some cases these producers stand ready to guarantee contract deliveries but apparently, the situation can be adjusted only by some meed of tariff protection which the producers are now advocating.

The marketing agreement between the naval stores industry and the Department of Agriculture has been signed and it provides for the payment of fees for tags to be affixed to the containers. The fees are:

"(1) Fifteen cents (15c) for each tag to be attached to a merchantable package of gum turpentine of approximately fifty (50) gallons net.

"(2) Five cents (5c) for each tag to be attached to a merchantable package of gum rosin of approximately five hundred (500) pounds.

"(3) Six cents (6c) for each tag to be attached to a metal package of rosin of approximately six hundred (600) pounds.

"(4) Fifteen cents (15c) for each fifty (50) gallons for a tag to be attached to a tank car or other receptacle of gum turpentine except the merchantable package referred to in (1) above.

"(5) One cent (1c) for each one hundred (100) pounds or fraction thereof for a tag to be attached to a tank car or other receptacle of rosin other than the merchantable package referred to in (2) and (3).

"(6) Six cents (6c) for each tag attached to a barrel of crude or cleaned gum of approximately fifty (50) gallons."

Permits under which distillers were able to market for beverage or other purposes, alcohol made from molasses and materials other than cereal grains, expired at the end of February and were not renewed. The situation now reverts to its prior status whereby 10 per cent of the ethyl alcohol used for the rectification of distilled spirits may be made from materials other than cereal grains under special permits.

Reports from abroad state that on Feb. 27 import licenses were approved in France for bringing into that country a total of 75,000 tons of synthetic nitrate of soda and that of the total amount an order for 40,000 tons was for American nitrate. Different reports have credited large shipments of American nitrate to foreign countries in the last few months.

Prices for the majority of important chemicals were on an unchanged basis throughout the last month. There is a firm undertone, however, and where price changes were made they were on the side of higher levels and there is evidence that the trend is still upward.

The most important revision of the period was found in the case of zinc oxide where an advance of three-quarters of a cent per pound was put into effect. This is in line with the belief that metal salts will work into higher territory as the metal markets become more firmly established.

Two factors which have arisen during the month are of interest. First is the proposal for a shorter working week for manufacturing industries. This is generally regarded as threatening an increase in operating costs with a consequent bullish effect on the sales prices for chemicals and other commodities. The second is concerned with tariff adjustments as an aid to increased foreign trade in both directions. Adjustments which would be favorable to an increase in importations of chemicals would mean a corresponding increase in foreign competition and may be construed as a bearish factor if it becomes a reality.

CHEM. & MET.
Weighted Index of
CHEMICAL PRICES

Base = 100 for 1927

This month	**88.86**
Last month	88.37
March, 1933	84.76
March, 1932	85.29

As a rule values held a steady position with a firm uhdertone. Zinc oxide was marked up in price and while naval stores failed to hold full advances, the average for the month was higher than in the preceding month.

CHEM. & MET.
Weighted Index of Prices for
OILS AND FATS

Base = 100 for 1927

This month	**56.30**
Last month	54.32
March, 1933	42.26
March, 1932	46.34

The price trend for vegetable oils and fats continued upward. Crude cottonseed oil was higher and the same held true for soya, peanut, and corn oils. Linseed oil closed unchanged. Animal fats were firmer throughout the period.

CURRENT PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to March 12.

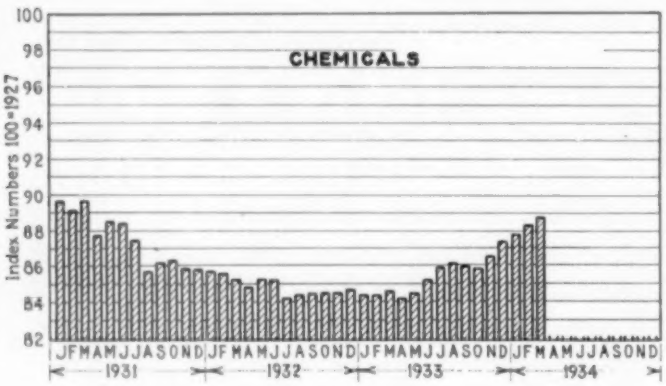
Industrial Chemicals

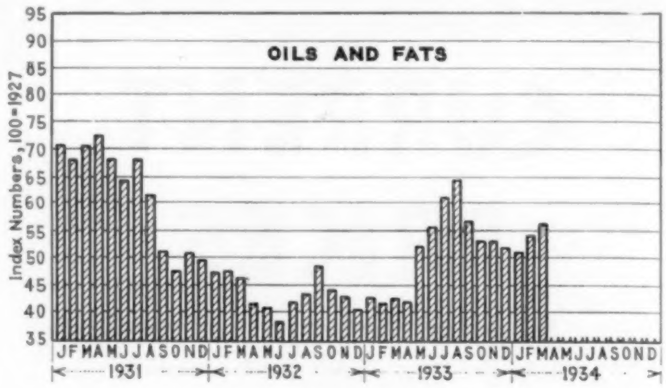
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.11 -$0.11½	$0.11 -$0.11½	$ .08½-$0.09
Acid, acetic, 28%, bbl., cwt.	2.90 - 3.15	2.90 - 3.15	2.65 - 2.90
Glacial 99%, drums	10.02 -10.27	10.02 -10.27	8.89 -......
U. S. P. reagent, c'bys	10.52 -10.77	10.52 -10.77	9.14 - 9.39
Boric, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Citric, kegs, lb.	.28 - .31	.28 - .31	.29 - .31
Formic, bbl., lb.	.11 - .11½	.11 - .11½	.10 - .11
Gallic, tech., bbl., lb.	.60 - .65	.60 - .65	.50 - .55
Hydrofluoric 30% carb., lb.	.07 - .07½	.07 - .07½	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18° tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb.	.11½- .12½	.11½- .12½	.11 - .12
Phosphoric, tech., c'bys., lb.	.09 - .10	.09 - .10	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -......	15.50 -......	15.50 -......
Tannic, tech., bbl., lb.	.23 - .35	.23 - .35	.23 - .35
Tartaric, powd., bbl., lb.	.25½- .26	.25½- .26	.20 - .21
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	4.15½-......	4.15½-......	2.53½-......
Alcohol, Butyl, tanks, lb.	.095-......	.095-......	.113-......
Alcohol, Amyl			
From Pentane, tanks, lb.	.15 -......	.15 -......	.143-......
Denatured, 190 proof			
No. 1 special dr., gal.	.346-......	.346-......	.34½-......
No. 5, 188 proof, dr., gal.	.34 -......	.34 -......	.38½-......
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Potash, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Aluminum sulphate, com., bags cwt.	1.35 - 1.50	1.35 - 1.50	1.25 - 1.40
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03	.02½- .03
tanks, lb.	.02¼- .02½	.02¼- .02½	.02¼- .02½
Ammonia, anhydrous, cyl., lb.	.15½- .16	.15½- .16	.15½- .15½
tanks, lb.	.04½-......	.04½-......	.05 -......
Ammonium carbonate, powd tech., casks, lb.	.08 - .12	.08 - .12	.08 - .12
Sulphate, wks., cwt.	1.25 -......	1.25 -......	1.00 -......
Amylacetate tech., tanks, lb., gal	.14½-......	.14½-......	.135-......
Antimony Oxide, bbl., lb.	.08½- .10	.08½- .10	.07 - .08
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb.	.14 - .14½	.14 - .14½	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	56.50 -58.00
Chloride, bbl., ton	74.00 -75.00	74.00 -75.00	63.00 -65.00
Nitrate, cask, lb.	.08½- .09	.08½- .09	.07½- .07½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.85 - 2.00	1.85 - 2.00	1.75 - 2.00
Borax, grain, bags, ton	40.00 -45.00	40.00 -45.00	40.00 -45.00
Bromine, cs., lb.	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	3.00 -......	3.00 -......	2.50 -......
Arsenate, dr., lb.	.07 - .08	.07 - .08	.05½- .06½
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	17.50 -......	17.50 -......	18.00 -......
flake, dr., wks., ton.	19.50 -......	19.50 -......	21.00 -......
Phosphate, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb.	.05½- .06	.05½- .06	.05 - .06
Tetrachloride drums, lb.	.05¼- .06	.05¼- .06	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.0185-......	.0185-......	.01¾-......
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb.	1.35 - 1.40	1.35 - 1.40	1.25 - 1.35

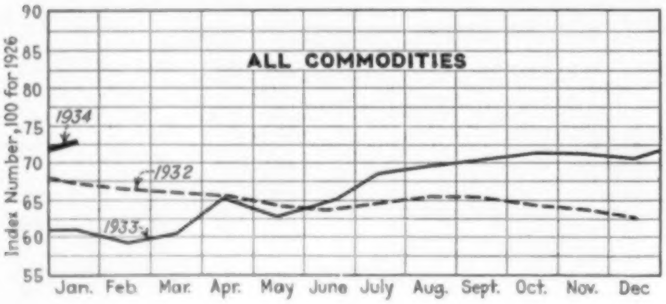
	Current Price	Last Month	Last Year
Copperas, bgs., f.o.b. wks., ton.	14.00 -15.00	14.00 -15.00	14.00 -15.00
Copper carbonate, bbl., lb.	.08¼- .16	.08¼- .16	.07 - .16
Cyanide, tech., bbl., lb.	.39 - .44	.39 - .44	.39 - .44
Sulphate, bbl., cwt.	3.75 - 4.00	3.75 - 4.00	3.00 - 3.25
Cream of tartar, bbl., lb.	.18 - .18½	.18 - .18½	.14½- .15
Diethylene glycol, dr., lb.	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	2.10 - 2.15	2.10 - 2.15	1.70 - 2.00
Imp., tech., bags, cwt.	2.00 - 2.10	2.00 - 2.10	1.15 - 1.25
Ethyl acetate, drums, lb.	.08½-......	.08½-......	.08½-......
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb.	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, crude, drums, gal.	.75 -......	.75 -......	1.10 - 1.20
Refined, dr., gal.	1.25 - 1.30	1.25 - 1.30	1.80 - 1.90
Glaubers salt, bags, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.12- .12½	.11½- .11¾	.10¼- .10½
Lead:			
White, basic carbonate, dry casks, lb.	.06½-......	.06½-......	.06 -......
White, basic sulphate, sck., lb.	.06 -......	.06 -......	.06 -......
Red, dry, sck., lb.	.07¾-......	.07¾-......	.06¾-......
Lead acetate, white crys., bbl.. lb.	.10½- .11	.10½- .11	.10 - .11
Lead arsenate, powd., bbl., lb.	.10 - .13	.10 - .13	.09 - .14
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk, lb.	.06¾-......	.06¾-......	.05¾-......
Lithophone, bags, lb.	.04½- .05	.04½- .05	.04½- .05
Magnesium carb., tech., bags, lb.	.06 - .06¼	.06 - .06¼	.05¾- .06
Methanol, 95%, tanks, gal.	.33 -......	.33 -......	.33 -......
97%, tanks, gal.	.34 -......	.34 -......	.34 -......
Synthetic, tanks, gal.	.35½-......	.35½-......	.35½-......
Nickel salt, double, bbl., lb.	.11½- .12	.11½- 12	.11 - .11½
Orange mineral, csk., lb.	.10½-......	.10½-......	.09¼-......
Phosphorus, red, cases, lb.	.45 - .46	.45 - .46	.42 - .44
Yellow, cases, lb.	.28 - .32	.28 - .32	.28 - .32
Potassium bichromate, casks, lb.	.07½- .08½	.07½- .08½	.07 - .08
Carbonate, 80-85%, calc. csk., lb	.07 - .07¼	.07 - .07¼	.05 - .06
Chlorate, powd., lb.	.09½- .10	.09 - .09½	.08 - .08½
Hydroxide (c'stic potash) dr., lb.	.07½- .07½	.07½- .07½	.06½- .06¾
Muriate, 80% bgs., ton	37.15 -......	37.15 -......	37.15 -......
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.05¾- .06
Permanganate, drums, lb.	.18½- .19	.18½- .19	.16 - .16½
Prussiate, yellow, casks, lb.	.18 - .19	.18 - .19	.16½ - .17
Sal ammoniac, white, casks, lb.	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt.	1.00 - 1.05	1.00 - 1.05	.90 - .95
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 -......	1.23 -......	1.15 -......
Dense, bags, cwt.	1.25 -......	1.25 -......	1.17½-......
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 - 3.00	2.60 - 3.00	2.50 - 2.75
Acetate, works, bbl., lb.	.04¾- .05	.04¾- .05	.04¾- .05
Bicarbonate, bbl., cwt.	1.85 - 2.00	1.85 - 2.00	1.85 - 2.00
Bichromate, casks, lb.	.05¾- .06¾	.05¾- .06¾	.044- .05
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb.	.03 - .04	.03 - .04	.03½- .04
Chlorate, kegs, lb.	.06¼- .06½	.06¼- .06½	.05¾- .07
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.15½- .16	.15½- .16	.15½- .16
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt.	3.25 - 3.40	3.25 - 3.40	3.60 - 3.75
Nitrate, bags, cwt.	1.35 -......	1.35 -......	1.295-......
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.021- .023	.021- .023	.018- .02
Prussiate, yel. drums, lb.	.11½- .12	.11½- .12	.11½- .12
Silicate (40° dr.) wks. cwt.	.80 - .85	.80 - .85	.70 - .75
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, cyrs., bbl., lb.	.02¼- .02½	.02¼ .02½	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -......	18.00 -......	18.00 -......
Chloride, dr., lb.	.03½- .04	.03½- .04	.03½- .04
Dioxide, cyl., lb.	.07 - .07½	.07 - .07½	.06½- .07
Flour, bag, cwt.	1.60 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin Oxide, bbl. lb.	.55 -......	.55 -......	.27½-......
Crystals, bbl., lb.	.38½-......	.37½-......	.24-......
Zinc chloride, gran., bbl., lb.	.05½- .06	.05½- .06	.06½- .06¾
Carbonate, bbl., lb.	.09½- .11	.09½- .11	.10½- .11
Cyanide, dr., lb.	.38 - .42	.38 - .42	.38 - .42
Dust, bbl., lb.	.07 - .07¼	.07 - .07¼	.04½- .05
Zinc oxide, lead free, bag, lb.	.06½-......	.05¾-......	.05¾-......
5% lead sulphate, bags, lb.	.06¼-......	.05½-......	.05½-......
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

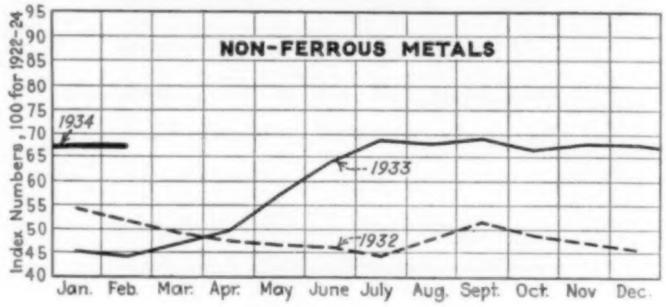
Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09¾-$0.10	$0.09¾-$0.10	$0.08¾-$0.09
Chinawood oil, bbl., lb.	.08 -......	.07¾-......	.05½-......
Coconut oil, Ceylon, tanks, N. Y. lb.	.02¾-......	.02¾-......	.03¼-......
Corn oil crude, tanks, (f.o.b. mill), lb	.04½-......	.04¼-......	.03½-......
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.04¼-......	.04 -......	.02¾-......
Linseed oil, raw car lots, bbl., lb.	.093-......	.093-......	.076-......
Palm, Lagos, casks, lb.	.03½-......	.03½-......	.02½-......
Palm Kernel, bbl., lb.	.04¾-......	.04¾-......	.04½-......
Peanut oil, crude, tanks (mill), lb.	.04¾-......	.04¾-......	.03½-......
Rapeseed oil, refined, bbl., gal.	.44 - .45	.42 - .43	.35 - .36
Soya bean, tank, lb.	.06½-......	.06 -......	....-......
Sulphur (olive foots), bbl., lb.	.06½-......	.06½-......	.04¾-......
Cod, Newfoundland, bbl., gal.	nom.	nom.	.19 - .21
Menhaden, light pressed, bbl., lb.	.051-......	.051-......	.03¼-......
Crude, tanks (f.o.b. factory), gal.	.15 -......	.15 -......	.09 -......
Grease, yellow, loose, lb.	.03½-......	.02¾-......	.02 -......
Oleo stearine, lb.	.05¾-......	.05½-......	.04 -......
Red oil, distilled, d.p. bbl., lb.	.07 -......	.07 -......	.06 -......
Tallow, extra, loose, lb.	.03½-......	.03½-......	.01¾-......









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.14½- .15
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal.	.20½- .21	.20½- .21	.20 - .21
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb.	.11 - .11½	.11 - .11½	.10½- .11
Cresylic acid, 97%, dr., wks., gal	.50 - .51	.50 - .51	.42 - .45
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.	.06 - .07	.06 - .07	.04½- .05
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Phenol, U.S.P., drums, lb.	.14¼- .15	.14¼- .15	.14¼- .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal.	1.10 - 1.15	1.10 - 1.15	.90 - .95
Resorcinal, tech., kegs, lb	.65 - .70	.65 - .70	.65 - .70
Salicylic acid, tech., bbl., lb.	.40 - .42	.40 - .42	.40 - .42
Solvent naphtha, w.w., tanks, gal.	.26 -......	.26 -......	.26 -......
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.30 -......	.30 -......	.30 -......
Xylene, com., tanks, gal.	.26 -	.26 -	.26 -

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb.	.12 - .13	.11½- .13	.07 - .10½
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 - .20	.04 - .20	.02½- .20
Prussian blue, bbl., lb.	.35 - .37	.35 - .36	.35 - .36
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb.	.26 - .27	.26 - .27	.27 - .30
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	3.90 - 4.50
Para toner, lb.	.80 - .85	.80 - .85	.75 - .80
Vermilion, English, bbl., lb.	1.58 - 1.60	1.48 - 1.50	1.10 - 1.30
Chrome yellow, C. P., bbl., lb.	.15 - .16	.15 - .15½	.16 - .16½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb.	.09 - .10	.08 - .09	.06 - .08
Manila, bags, lb.	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb.	.15½- .16	.15 - .15½	.16 - .16½
Kauri No. 1 cases, lb.	.20 - .25	.20 - .25	.45 - .48
Kieselguhr (f.o.b. N.Y.), ton.	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton.	50.00 -......	50.00 -......	40.00 -......
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	6.45 -......	6.175-......	4.10 -......
Turpentine, gal.	.62 -......	.60½-......	.48½-......
Shellac, orange, fine, bags, lb.	.26 - .27	.26 - .27	.19 - .20
Bleached, bonedry, bags, lb.	.29 - .31	.29 - .31	.18 - .19
T. N. bags, lb.	.21 - .22	.21 - .22	.08½- .09
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 -	13.75 - ...	13.75 -

INDUSTRIAL NOTES

CARBIDE AND CARBON CHEMICALS CORP., New York, has appointed Smead & Small, Inc., Cleveland, as distributor of ethyl alcohol in northern Ohio territory and Rogers & McClellan, Boston, as distributor in the New England territory.

THE PATTERSON FOUNDRY & MACHINE CO., East Liverpool, Ohio, has opened an office at 7338 Woodward Ave., Detroit, with Edwin L. Grimes as district manager.

DARCO SALES CORP., New York, has moved its offices from 45 East 42d St., to 60 East 42d St.

THE PITTSBURGH EQUITABLE METER CO., Pittsburgh, and its subsidiary, the Merco Nordstrom Valve Co., announce that they have established a new district to serve the territory of central and western New York. C. F. Thomas, who has been acting as New York representative, will be district manager in charge of the new territory, assisted by D. A. Gardner.

AIR REDUCTION CO., INC., New York, has exercised its option on the balance of the capital stock of the Wilson Welder and Metals Co., North Bergen, N. J.

INGERSOLL-RAND CO., New York, has acquired the turbo-blower business of the General Electric Co., and will consolidate it with its own turbo-blower department. Equipment formerly used by General Electric is being moved to Ingersoll-Rand plant at Phillipsburg, N. J.

THE ELGIN SOFTENER CORP., Elgin, Ill., announces the appointment of the L. A. Snider Engineering Service, 605 N. Michigan Ave., Chicago, as representatives in northern Illinois and Indiana.

ALLIS-CHALMERS MFG. CO., announces that on Feb. 24, its Buffalo office was moved to the Liberty Bank Bldg.

THE HAYS CORP., Michigan City, Ind., has appointed the following new representatives: T. C. Messplay, 2219 E. 69th Terrace, Kansas City, Mo., for Kansas and western Missouri; Fairman B. Lee, 114 Railroad Ave. South, Seattle, for Washington; Leinart Engineering Co., 427 Walnut St., Knoxville, for eastern Tennessee; and Engineering Sales Co., Holland, for western Michigan.

D. W. HAERING & CO., Chicago, has made the following additions to its Eastern sales staff operating from the recently opened New York office: Edwin H. Chandler, in Rhode Island; and Albert Nickerson, Albert Stewart, C. W. MacKinnon, in Massachusetts.

JAS. P. MARSH CORP., Chicago, has appointed J. N. Kane, Box 1552, Fort Worth as its sales representative in that district of Texas.

NEW CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative to Date	
	Proposed Work and Bids	Contracts Awarded	Proposed Work and Bids	Contracts Awarded
New England	$325,000	....	$504,000	$28,000
Middle Atlantic	186,000	$123,000	924,000	421,000
Southern	9,750,000	90,000	11,459,000	915,000
Middle West	345,000	75,000	1,521,000	740,000
West of Mississippi	365,115	60,000	3,155,000	158,000
Far West	660,000	53,000	935,000	184,000
Canada	1,052,000	....	1,523,000	....
Total	$12,433,000	$401,000	$20,021,000	$2,446,000

PROPOSED WORK

BIDS ASKED

Acetylene Plant — American Acetylene Co., Leslie M. Wise, Mgr., McKeesport, Pa., has acquired a site in Versailles Township, McKeesport, and is having plans prepared for an acetylene plant.

Cement Plant—Asphalt Emulsion, Flooring & Roofing, Ltd., c/o S. H. R. Bush, St. James St., Montreal, Que., contemplates the construction of a plant for the manufacture of cement, asphalt, etc.

Cement Plant—Santa Cruz Portland Cement Co., G. R. Day Morgan, Crocker Bldg., San Francisco, Calif., contemplates the construction of a cement plant at Portland, Ore. Estimated cost $100,000.

Chemical Plant — Canadian Industries, Ltd., Robert Salmon, Mgr., 1050 Beaver Hall Hill, Montreal, Que., plans the construction of a chemical plant. Estimated cost $900,000.

Chemical Plant—Oxygen Co. of Canada, Ltd., H. Edward Reilly, Director, 1458 Mansfield St., Montreal, Que., is considering plans for the construction of a plant for the manufacture of chemicals, compound gases, etc.

Chemical Plant—Shell Oil Co., Shell Bldg., San Francisco, Calif., is having plans prepared by its Engineering Department for additions to its chemical plant at Martinez, Calif. New equipment will be installed. Estimated cost $250,000.

Cotton Seed Oil Plant—Cotton Growers Co-operative Association, Tornillo, Tex., contemplates the construction of a cotton seed oil plant. Estimated cost $35,000.

Distillery—Bird Distilling Co., Lexington, Ky., plans to recondition its distillery. Estimated cost $35,000.

Distillery — Churchhill Downs Distilling Co., Churchhill Downs, Nelson Co., Ky., plans to alter and recondition its distillery. Estimated cost $35,000.

Distillery — Commercial Solvents Corp., 230 Park Ave., New York, N. Y., plans to alter and construct additions to plant at Terre Haute, Ind., to be used for the manufacture of whiskey. Estimated cost $50,000.

Distillery — Dant Distillery Co., Dant, Ky., plans to recondition and build addition to distillery. Estimated cost $30,000.

Distillery—Dant & Head Distilling Co., Gethsemane, Ky., plans to recondition and build addition to distillery. Estimated cost $30,000.

Distillery — Dunlievy Distilling Corp., San Diego., Calif., plans to construct a distillery on Rough and Ready Island, Stockton. Estimated cost $250,000.

Distillery—Krogman Distilling Co., Tell City, Ind., plans to construct distillery. Estimated cost $40,000.

Distillery—H. McKenna, Fairfield, Ky., plans to recondition its distillery. Estimated cost $30,000.

Distillery — C. P. Moorman, Louisville, Ky., plans to alter his distillery. Estimated cost $30,000.

Distillery—Interests represented by Hunt-Mirk & Co., Engrs., 141 Second St., San Francisco, Calif., are having plans prepared for the construction of a distillery in the Sacramento Valley district. Engineers are interested in receiving bids on distillation equipment. Estimated cost $60,000.

Distillery—Old Hackley Distilling Co., Lawrenceburg, Ky., plans to recondition and enlarge its distillery. Estimated cost $30,000.

Distillery—A. Overholt & Co., R. C. Berry, Mgr., Bradford, Pa., plans to improve the local distillery, including new boilers, etc. Estimated cost $100,000.

Distillery—J. Walsh Co., E. A. O'Shaughnessy, Supt., Lawrenceburg, Ind., plans the construction of a distillery. Estimated cost $28,500.

Gas Plant—City, Aledo, Ill., is having plans prepared by McBride Gas Engineering Co., 2639 Locust Ave., St. Louis, Mo., for the construction of a gas plant and distribution system. Will apply for P.W.A. loan and grant. Estimated cost $97,870.

Gas Plant—City, Geneseo, Ill., is having preliminary surveys made by Warren & VanPraag, Engrs., Decatur, Ill., for a natural gas plant and distributing system.

Gasoline Plant—Hanlon-Buchanan, Inc., Gladewater, Tex., plans the construction of a 25,000 gal. capacity natural gasoline plant. Estimated cost $80,000.

Glue Factory—New England Chemical Industry (associated with Pacific Bone, Coal & Fertilizer Co.), South San Francisco, Calif., is having plans prepared by Ellison & Russell, Engrs., Pacific Bldg., San Francisco, for the construction of a glue factory at Boston, Mass. Estimated cost $250,000.

Laboratory—Augustana College, Rock Island, Ill., is having plans prepared by Childs & Smith, Archts., 720 North Michigan Ave., Chicago, Ill., for the construction of the Wallberg Hall of Science. Laboratory equipment will be required. Estimated cost $100,000.

Laboratory—Krebs Pigment & Color Co., 2001 Bonhill Ave., Baltimore, Md., is receiving bids for the construction of a laboratory and office building. Estimated cost $30,000.

Laboratory—U. S. Department of Agriculture, Division of Sales, Purchases & Traffic, Washington, D. C., will soon receive bids for the construction of an isolation poultry laboratory at Beltsville, Md.

Pottery Plant—Tillsom Pottery, Ltd., William Joyce, Wentworth, Ont., Mgr., plans the construction of a pottery plant at Weston, Ont.

Pulp and Paper Mill—Municipality, Fernandina, Fla., has aplied to the Public Works, Administration, Washington, D. C., for a loan of $4,500,000 to be used for the construction of a pulp and paper mill to be leased to the Union Bag & Paper Co., Woolworth Bldg., New York, N. Y. Maturity indefinite.

Wall Paper Plant—Kentucky Wall Paper Co., 615 West Main St., Louisville, Ky., plans to alter and repair its plant. Estimated cost $30,000, including equipment.

Rayon Plant—E. I. duPont de Nemours & Co., Wilmington, Del., plans the construction of additions to its rayon plant at Sumpthill, near Richmond, Va. Estimated cost $5,000,000.

Rubber Plant—F. H. Clapp Rubber Co., Pembroke, Mass., contemplates rebuilding the drying house at its plant. New equipment will be required. Estimated cost $75,000.

Sodium Sulphate Plant—Metallics & Non-Metallics, Ltd., Maple Creek, Sask., plans the construction of a sodium sulphate plant at the Engebright Deposit near Maple Creek. Estimated cost $40,000.

Tin Mill—American Tin Co., Magdalena, N. M., plans the construction of a 100 ton mill on its property here. H. D. Ramsay, Berkeley, Calif., is manager.

CONTRACTS AWARDED

Chemical Factory—Tohm & Haas Co., 222 West Washington Sq., Philadelphia, Pa., awarded contract for chemical factory, Building No. 30, at Bristol, Pa., to A. Raymond Raff Co., 1635 West Thompson St., Philadelphia, Pa. Estimated cost $40,000.

Crystallizer Building—Krebs Pigment & Color Co., 2001 Bonhill Ave., Baltimore, Md., awarded contract for construction of crystallizer building to Carl W. Schmidt, Munsey Bldg., Baltimore. Estimated cost $20,000.

Distillery — Buffalo Springs Distilling Co., Stampting Ground, Ky., awarded separate contracts for constructing distillery. Estimated cost $50,000.

Distillery—Ruffsdale Distillery, Ruffsdale, Pa., awarded separate contracts for constructing extension and altering yeast building and power plant. Estimated cost $35,000.

Gin Still—Penn York Distilleries, Shrewsbury, Pa., will build a gin still. Separate contracts will be awarded for construction and equipment. Estimated cost $28,000.

Ink Factory—G. H. Morrill Co., 130 Fremont St., San Francisco, Calif., awarded contract for addition to its factory on South Linden St., South San Francisco, to Dinwiddie Construction Co., Crocker Bldg., San Francisco. Estimated cost $25,000.

Glass Factory—Glass Containers, Inc., Vernon, Calif., is building a 1 and 2 story factory for the manufacture of glass containers. Work is being done under the supervision of John M. Cooper, Archt., 6231 West 6th St., Los Angeles, Calif.

Pottery Plant—Hall China Co., East Liverpool, O., awarded contract for two additions to its plant to Potters Lumber Co., East Liverpool, O. Estimated cost $75,000.

Pottery Plant—Harker Pottery Co., Chester, W. Va., awarded contract for circular tunnel bisque kiln at plant to Ladd-Cronin Engineering Co., East Liverpool, O. Estimated cost $40,000.

Refinery—Panhandle Refining Co., c/o W. F. Sims, Supt., Box 1191, Wichita Falls, Tex., will build an oil and gas refinery. Work will be done by day labor. Estimated cost $60,000.

CARBON DIOXIDE

Year	Production Liquid Lb.	Production Solid Lb.	Imports Lb.	Exports Lb.	Average Price Liquid Lb.	Average Price Solid Lb.
1923	51,095,965	....	......	......	10.25c.	....
1927	74,344,287	....	......	......	8.25c.	6c.
1929	136,930,311*	....	......	......	7c.	5c.
1931	180,471,183	84,954,018	......	......	6.5c.	3.5c.
1932	....	....	......	......	6c.	3c.
1933	....	....	......	......	6c.	3c.

*Amount for sale.

Grades: Liquid, solid.

Uses: Liquid: carbonated beverages, refrigeration, manufacture solid carbon dioxide, urea, fire extinguishers, fumigants.
Solid: refrigeration, fire extinguishers, low-freezing lubricating oils, bacteriological work.

Manufacturers: *American Carbonic Co., Harrison, N. J.; †American Dryice Corp., N. Y. City; ‡California Carbonic Co., Los Angeles; ‡Carbo Chemical Co., Salt Lake City; ‡Carbonic Mfg. Co., N. Y. City; ‡Crystal Carbonic Laboratory, Atlanta; *The Liquid Carbonic Corp., Chicago; †Mathieson Alkali Works, N. Y. City; †Michigan Alkali Co., N. Y. City; ‡National Carbonic Co., San Antonio; †Nu-Ice Corp., Los Angeles; ‡Pacific Silicate Co., San Francisco; *Parker-Browne Co., Fort Worth; *Pure Carbonic Co. of America, N. Y. City; ‡Southern Oxygen Co., South Washington, Va.; ‡Sparkling Carbonic Co., Cincinnati; ‡Wall Chemicals, Detroit; ‡Washington Liquid Gas Co., Seattle; *Zero Ice Corp., Detroit.

* Make both. † Make solid only. ‡ Make liquid only.

BROMINE

Year	Production Lb.	Imports Lb.	Exports Lb.	Average Price Lb.
1923	842,352	782	....	30c.
1927	1,756,310	....	....	45c.
1929	6,414,620	17,573	....	45c.
1931	8,935,330	25	....	41.25c.
1932	5,727,561	27	....	36c.
1933				36c.

Grades: C. P., U.S.P., Tech.

Uses: Manufacture bromides, dyes, tetraethyl lead, pharmaceuticals, organic synthesis, poison gas.

Producers: California Chemical Corp., Chula Vista, Calif.; J. Q. Dickinson & Co., Malden, W. Va.; Dow Chemical Co., Midland, Mich.; Ethyl-Dow Chemical Co., Kure Beach, N. C.; Excelsior Salt Works, Pomeroy, Ohio; Liverpool Salt & Coal Co., Hartford, W. Va.; Morton Salt Co., Manistee, Mich.; Ohio River Salt Corp., Mason, W. Va.; Pomeroy Salt Corp., Minersville, Ohio.

ZINC DUST

Year	Production Tons	Imports Lb.	Exports Lb.	Average Price Lb.
1923	8,052	8,000	7,358,000	8.4c.
1927	8,098	815	2,713,196	8.3c.
1929	11,050	317,220	2,511,381	8.4c.
1931	10,611	2,204	2,799,598	5.4c.
1932	8,046	....	2,755,755	4.8c.
1933	11,157	....	3,138,261	5.9c.

Grades: Tech., blue powder and atomized.

Uses: dyes, intermediates, dyeing and printing textiles, sherardizing, mining.

Manufacturers: The Alloys Co., San Francisco; American Smelting & Refining Co., N. Y. City; Federated Metals Co., Trenton, N. J.; John Finn Metals Works, San Francisco; Grasselli Chemical Co., Meadowbrook, W. Va.; New Jersey Zinc Co., Palmerton, Pa.; Superior Zinc Corp., Phila.

CARBON BISULPHIDE

Year	Production Lb.	Imports Lb.	Exports Lb.	Average Price Lb.
1923	30,559,033	......	....	6.5c.
1927	55,531,106	......	....	5.5c.
1929	71,009,798	......	....	5c.
1931	83,045,219	......	2,090,855	5c.
1932	....	......	2,957,601	5c.
1933	....	....	2,994,720	5.5c.

Grades: U.S.P., Tech.

Uses: Viscose rayon, carbon tetrachloride, paint removers, matches, germicides, solvent.

Manufacturers: Dow Chemical Co., Midland, Mich.; Niagara Smelting Co., Niagara Falls, N. Y.; Pennsylvania Salt Mfg. Co., Phila.; Stauffer Chemical Co., San Francisco; Taylor Chemical Corp., Penn Yan, N. Y.; Virginia Smelting Co., West Norfolk; Westvaco Chlorine Products Co., South Charleston, W. Va.

Plants: 9; N. Y. 2, Pa. 2, Calif., Mich., Tenn., Va., W. Va., 1 each.

ZINC CHLORIDE

Year	Production Lb.	Imports Lb.	Exports Lb.	Average Price Lb. Fused
1923	64,575,076	1,102,000	....	5.25c.
1927	58,268,485	939,301	....	5.25c.
1929	77,232,392	1,275,053	....	5.75c.
1931	69,770,000*	556,116	....	5.25c.
1932	47,048,000*	502,000	....	5.25c.
1933	....	....		5c.

*Sales.

Grades: U.S.P.; C.P.; Tech., fused, granular, crystal, solution.

Uses: Wood preservation, vulcanized fiber, dry batteries, disinfectant, pharmaceuticals, petroleum refining.

Manufacturers: American Smelting & Refining Co., N. Y. City; Chas. Cooper & Co., Newark, N. J.; General Chemical Co., N. Y. City; Grasselli Chemical Co., Cleveland; Illinois Smelting & Refining Co., Chicago; Chas. Lennig & Co., Phila.; Merrimac Chemical Co., Boston; Monsanto Chemical Co., St. Louis; New Jersey Zinc Co., N. Y. City; Vulcan Detinning Co., Sewaren, N. J.

Additions and Corrections

On editorial supplement to Chem. & Met., January, 1934, add the following:

Barium Sulphate
Manufacturers: Grasselli Chemical Co., Grasselli, N. J.

Litharge
Manufacturers: Hammond Lead Products Co., Hammond, Ind.

Red Lead
Manufacturers: Hammond Lead Products Co., Hammond, Ind.

Sodium Phosphate
Manufacturers: Grasselli Chemical Co., Grasselli, N. J.

Tin Chloride (Stannic)
Manufacturers: Metal & Thermit Corp., New York, N. Y.; Vulcan Detinning Co., Sewaren, N. J.

Zinc Oxide
Manufacturers: Anaconda Zinc Oxide Dept. of International Lead Refining Co., Akron, Ohio, and East Chicago, Ind.; Loewenthal Metals Corp., Chicago; Superior Zinc Oxide Co., Phila. Production: in 1931 was 144,277 and in 1932 was 86,555 short tons.

Aluminum Chloride
Manufacturer: Savell, Sayre & Co., Niagara Falls, N. Y.

Sodium Silicate
Manufacturer: Philadelphia Quartz Co. purchased Utica, Ill., plant and sodium silicate business of Central Commercial Chemical Co.; Stauffer Chemical Co. is not a manufacturer, but is part owner of the Philadelphia Quartz Co. of Calif.

Amyl Alcohol & Acetate
U.S. Census figures show only production of organic chemical industry. The 1929 total for amyl alcohol, primary and secondary, was 4,081,000 lb. For amyl acetate primary and secondary, 4,963,000 lb.

New Data on Chemical Raw Materials for Process Industries

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Continued from *Chem. & Met*, February, 1934, page 112.